

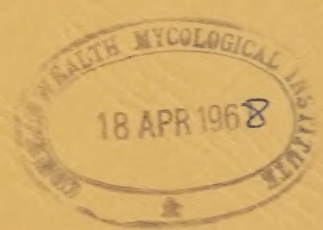
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ANNUAL REPORT

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DEPARTMENT OF AGRICULTURE
NEW SOUTH WALES

1967

PARLIAMENT OF NEW SOUTH WALES

REPORT
OF THE
DEPARTMENT OF AGRICULTURE
FOR THE
Year ended 30 June, 1967

Ordered to be printed, 26 October, 1967

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REPORT

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE

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- I. The Accounts of the Department of Agriculture for the Year ended 30th June, 1967.
- II. The Published Matter of Officers of the Department of Agriculture for the Year ended 30th June, 1967.
- III. Schools and Courses wherein the Department of Agriculture was a Major Staffing and/or Organizing Element in 1966-67.
- IV. Notes from Staff Branch (on Staff Appointments/Promotions; Staff Numbers; Retirements; Deaths) in 1966-67.

ADMINISTRATIVE AND SENIOR SUPERVISORY PERSONNEL*

As at 30th June, 1967

Minister for Agriculture	Hon. W. A. CHAFFEY, M.L.A.
Director-General	R. M. WATTS.
Deputy Director-General (R.E.)	Dr F. C. BUTLER.
Deputy Director-General (P.T.)	B. O. FRENCH.
Secretary	J. L. HAGER.
Assistant Secretary	S. W. WISE.
Accountant	K. A. RUSSELL.
Pastures Protection Officer	D. MCGREGOR
Legal Officer	S. T. BEAL.
Chief Biometrician	F. C. MCCLEERY.
Chief of Research Administration.....	Dr S. L. MACINDOE.
Division of Plant Industry—	
Chief.....	W. H. G. POGGENDORFF.
Deputy Chief	A. C. ORMAN.
Principal Agronomist (Research)	L. R. KAVANAGH.
Principal Agronomist (Extension)	E. W. BOWMAKER.
Principal Agronomist (Pastures).....	W. T. ATKINSON.
Principal Agronomist (Miscellaneous Crops)	J. E. JESSUP.
Division of Horticulture—	
Chief	R. G. KEBBY.
Deputy Chief	G. R. GREGORY.
Principal Fruit Officer (Extension)	E. C. CONNOR
Principal Fruit Officer (Research)	J. K. LONG.
Principal Fruit Officer (Regulatory)	A. K. SKEPPER.
Principal Fruit Officer (Viticulture)	Vacant.
Senior Inspector (Export and Import Branch)	R. W. ROBERTSON.
Division of Animal Industry—	
Chief.....	R. A. HALL.
Deputy Chief	J. N. HENRY.
Director of Veterinary Research	J. C. KEAST.
Principal Veterinary Research Officer	E. J. H. MCBARRON.
Chairman, Board of Tick Control	A. N. A. HARRIS.
Director of Cattle Tick Research	Dr R. N. MCCULLOCH.
Principal Veterinary Officer.....	D. G. CHRISTIE.
Principal Veterinary Officer (Extension)	J. S. HEALEY.
Principal Veterinary Officer (Meat Inspection)	R. C. CRAMP.
Principal Livestock Officer (Sheep and Wool)	C. J. HAWKINS.
Principal Livestock Officer (Beef Cattle, Horses and Goats)	W. J. B. MURPHY.
Principal Livestock Officer (Pigs)	N. A. STEEL.
Principal Livestock Officer (Poultry)	G. D. SLENNETT.
Principal Livestock Officer (Apiculture)	A. A. CLEMSON.
Division of Dairying—	
Chief.....	D. W. CROWFOOT.
Deputy Chief	C. E. CHAPMAN.
Principal Dairy Officer	E. G. McLAREN.
Principal Dairy Officer (Herd Improvement)	D. R. SCOTT.
Principal Dairy Officer (Hawkesbury Agricultural College)	Dr G. J. F. SMITH.
Division of Science Services—	
Chief	T. H. JOHNS.
Chief Biologist	W. S. SUTTON.
Chief Entomologist	G. A. PASFIELD.
Chief Chemist	A. N. OLD.
Director of the Royal Botanic Gardens and National Herbarium and Chief Botanist	H. K. MAIR.

* For more detail of staff of the various Divisions, Branches, etc., see New South Wales Department of Agriculture brochure *Directory of Officers*.

For staff number totals see tabulation in this Report, Appendix IV.

ADMINISTRATIVE AND SENIOR SUPERVISORY PERSONNEL

As at 30th June, 1967—*continued*

Division of Information Services—

Chief.....	H. PARRY BROWN.
Editor of Publications	W. R. TURNER.
Special Extension Officer (Agricultural Bureau and Group Work)	J. J. SLATER.
Senior Extension Officer (Women's Service)	Miss N. M. FOSKETT.
Research Liaison Officer (Scientific Publications) ..	J. N. POTTER.
Librarian-in-Charge	J. C. HAZELL.

Division of Marketing and Agricultural Economics—

Chief.....	C. J. KING.
Deputy Chief	P. C. DRUCE.

Hawkesbury Agricultural College—

Principal	B. DOMAN.
Deputy Principal	W. J. C. HUDSON.
Farm Supervisor	T. ADAMS.

Wagga Agricultural College and Experiment Station—

Principal	B. F. ATKINS.
Deputy Principal	J. R. SUTHERLAND.
Farm Supervisor	J. C. BALLANTYNE.

Wagga Agricultural Research Institute—

Director	Dr A. T. PUGSLEY.
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Regional Extension Services—

Chief.....	J. L. GREEN.
Principal Extension Officer (Regional Services)	B. D. AMENT.
Regional Supervisors of Agriculture—	
Southern Region	R. C. MADSEN.
North Coast Region	F. AUTRY-HALL.
Western Region	H. T. HARRISON.
South Coast and Tablelands Region	R. W. SHELLEY.
South Western Region	E. TINDALE.
Northern Region	G. R. GODDEN.
Mid Coast and Hunter Region	N. W. VANE.
Mid Western Region	F. J. NICHOLSON.
North Western Region.....	H. P. HALL.

Research Stations—

Chief, Research Stations Branch	N. K. GOLDING.
Principal Officer (Management)	E. C. POWELL.
Architect	B. A. CHADWICK.
Agricultural Engineer	J. G. DREVER.
Bathurst Agricultural Research Station .. Manager	J. R. DAVISON.
Condobolin Agricultural Research Station .. Manager	K. V. SIMMONS.
Cowra Agricultural Research Station .. Manager	J. M. ARTHUR.
Dareton Horticultural Research Station .. Manager	M. C. STANNARD.
Glenfield Veterinary Research Station .. Director	J. C. KEAST.
Grafton Agricultural Research Station .. Manager	C. E. COLLINS.
Griffith Viticultural Research Station .. O.I.C.	A. F. MURRAY.
Leeton Agricultural Research Station .. Manager	P. A. WITSCHI.
Narrabri Agricultural Research Station .. Manager	D. A. PEARSON.
Narara Horticultural Research Station .. Manager	L. F. MANDELSON.
Agricultural Research Station, Glen Innes Manager	R. I. JOHNSON.
Poultry Research Station, Seven Hills	Manager
Tamworth Agricultural Research Station .. Manager	J. A. LOVERIDGE.
Tamworth Agricultural Research Station .. Director of Research	Dr W. V. SINGLE.
Temora Agricultural Research Station .. Manager	R. THOMSON.
Trangie Agricultural Research Station .. Manager	G. G. DARLING.
Wollongbar Agricultural Research Station .. Manager	J. C. ENGLAND.
Yanco Agricultural College and Research Station	Principal
Alstonville Tropical Fruit Research Station .. O.I.C.	F. D. MACKENZIE.
	C. A. EADY.
Dairy Industry Research (North Coast)	Supervisor
	Dr J. M. HOLDER.

NEW SOUTH WALES

DEPARTMENT OF AGRICULTURE

Report of the Director-General to the Minister for the Year ended 30th June, 1967

Department of Agriculture, Sydney, 20th October, 1967.

Dear Sir,

Herewith the Report of the Department of Agriculture for the 12 months ended 30th June, 1967.

NOTES FROM CENTRAL ADMINISTRATION

Notes on the Seasons

Though drought continued to cast a shadow over New South Wales during 1966-67, it did not have the same disastrous effect on the rural sector as in the preceding season. Crop output overall was highly satisfactory.

The drought was still affecting much of the countryside in July, 1966, and the outlook was grim until in August, towards the end of winter, the entire State except mainly the Western Division received really worthwhile rains. Useful follow-up rains occurred in September but unfortunately the greater part of the Western Division again received only light and patchy falls.

The August and September rains in cereal growing districts were of great benefit. Pastures also responded and by early spring there was reasonable to good grazing over most of the eastern half of the State. Especially notable in this period was the rapid recovery of pastures in much of the critically drought-stricken northern inland. Still the pastoral position in the western half of the State was extremely patchy; short feed in some places but in many others the pastures in very poor condition.

Assisted by moderate to very good rainfall the feed-situation gradually showed improvement during the last quarter of 1966, though hot weather in late November in most areas and again in late December dried off the pastures.

At the close of 1966 the overall picture comprised fair to good feed over much of the State. Main exceptions were some coastal areas, the far northern plains and parts of the Western Division—especially the southwestern corner, where conditions again bordered on drought and rain was an urgent need.

Warm to hot weather prevailed in most districts in January and February, 1967, and with continued lack of good rains in late summer the pastoral position deteriorated in many inland areas. Hand-feeding became necessary in many places.

As March opened, coastal and some adjacent tableland districts were in reasonable to good order. Elsewhere the situation was deteriorating, particularly on the northern slopes and plains. In many Western Division areas drought or near-drought prevailed. The outlook was grim in these badly affected localities. Another unhappy autumn-winter was in prospect.

Very welcome rains in the first half of March revitalized the hard-hit northern inland and upper Western Division in particular. Pasture response was good.

The north coast rivers districts also received heavy falls shortly after mid-March. There were floodings along the Richmond River and parts of the Clarence and Tweed Rivers but no serious stock-losses.

Unfortunately the position inland again deteriorated, under the return of dry and windy conditions late in March. April and May rainfall was below normal, though there were a few useful recordings in May; and in June the Western Division, the Riverina and slopes again had less than average.

Torrential rains on the north coast in the second week of June caused major flooding of all coastal rivers, from the Macleay north to the Queensland border, with minor to moderate floodings southwards to the Hunter. The June

floods ruined pastures and fodder crops over a wide area of the north coast and destroyed many fodder reserves. Elsewhere the June rains, coupled with mild conditions and the absence of heavy frosts, were most welcome and eased the pastoral-situation. Natural and improved pastures as well as grazing-crops responded in many areas, though slowly in the colder places.

At the end of June, 1967, prospects had generally improved and most areas were expected to enter the spring in a fairly sound condition provided rainfall were adequate in late winter. Main exceptions were the waterlogged sections of the north coast, and also the still dry lower Western Division and parts of the southwestern slopes and Riverina where the feed position was far from satisfactory. It is notable that on the southwestern slopes and in the Riverina and Lower Western Division, rainfall was below average in each of the six months from January to June, 1967.

Sowing of the 1967 wheat crop was delayed by rain insufficiencies. The June falls came just in time, in many parts of the wheat belt, to enable farmers to fulfil their intended sowings.

Total wheat-sowings were estimated by the Department to have approached 8,000,000 acres, considerably above the record 7,000,000 acres sown in 1966. Another heavy wheat-crop was likely but, as the subsoil moisture position was quite varied, above-average spring rains would be essential—especially in the central and southern areas—as would favourable seasonal conditions for the rest of 1967.

Notes on Commodity Production

Though the drought continued into 1966-67, this was a good production-year with most primary products. In fact, output for the major four cereals—wheat, oats, barley, and rice—greatly exceeded the previous records.

CEREALS

Record Wheat

The 1966-67 wheat grain-harvest in N.S.W., is estimated to have totalled in excess of 200,000,000 bushels, the highest ever. It was more than five times greater than the drought-affected 1965-66 crop of 39,100,000 bushels, and some 48,500,000 bushels above the previous record of 151,500,000 bushels achieved in 1964-65.

This was the first time that output had approached 200,000,000 bushels. Yet only four seasons ago production exceeded 100,000,000 bushels for the first time.

The output was about 43 per cent of the record Australian production, estimated at 460,000,000 bushels; and almost double that of the next from largest-producing State, Western Australia.

The area sown for all purposes was provisionally estimated at 7,200,000 acres, including 7,000,000 acres sown for grain. Each figure was well above the previous record. All-purpose acreage for the drought-affected 1965-66 season was 4,794,000 acres, including 4,577,000 acres sown for grain.

The yield-average per acre was 28.6 bushels, compared with the previous record (1964-65) of 26.3 bushels.

Record Oats

The oat grain-harvest was estimated at 40,800,000 bushels, much greater than the previous record (1958-59) of 27,638,500 bushels. The yield-average of 30.0 bushels per acre considerably exceeded the record (1964-65) of 26.9 bushels.

Area sown for all purposes approximated 2,186,000 acres, including 1,362,000 acres for grain. Comparative figures for the drought-affected 1965-66 season were 1,737,000 acres sown for all purposes; 1,033,000 acres for grain.

Record Barley

The barley grain-harvest, 11,800,000 bushels, was also the highest ever. The previous record (1964-65) was 6,707,000 bushels, and the drought-affected 1965-66 crop was only 3,802,000 bushels.

Both the area sown for grain, 385,400 acres, and the yield-average of 30.6 bushels per acre were records. The grain-area in 1965-66 was 236,000 acres and the per acre yield-average only 16.1 bushels.

Maize

The maize grain-harvest totalled 2,547,000 bushels in 1966, second from highest in the past 20 years; the 2,859,700 bushels in 1958 was the highest in the 20 years.

Pre-war there had been many years when the output was exceeded. The record crop was 7,594,100 bushels in 1910.

The area sown for grain last season was 70,500 acres (compared with the 42,000 acres in the previous year) and the per acre yield-average was 36.1 bushels.

Grain Sorghum

The grain sorghum harvest reached 1,526,000 bushels in 1966, well above the drought-affected 1965 crop of 604,500 bushels. Area sown for grain was 98,150 acres, slightly below the 99,640 acres planted in 1965.

Rice Records

Rice production continued to increase. The 1967 crop totalled 210,940 tons of paddy from a sown area of 73,820 acres. Area sown and the production was each a record. The harvest was more than 30,000 tons greater than in 1966 and more than double the production achieved only 10 years ago.

The per acre yield-average of 2.86 tons was a new world-record, the previous best being the 2.79 tons per acre achieved in this State in the previous year.

For the first time, production of Caloro was exceeded by another variety. Output of Calrose was slightly the greater this year.

FIBRE AND OIL CROPS, ETC.

Cotton

Total cotton production in 1967 was estimated at 52,500 bales from a sown area of some 30,400 acres. The yield-average per acre has been estimated as 1.73 bales.

Tobacco

There were only 1,765 acres of this crop in New South Wales in 1966-67 but this was a 9 per cent increase on the 1965-66 acreage. The yield was 2,100,000 lb of cured leaf, about 1,200 lb/acre, and the quality overall was better than in the previous year.

Linseed

The 8,000 acres sown to linseed was about four times that sown during the drought, and produced about 3,000 tons; a satisfactory yield-average of 14 bushels/acre. In some experiment-areas there were yields exceeding 30 bushels/acre.

Safflower

Almost 6,000 acres were sown to safflower; 5,500 in the northwest. The N.S.W. acreage had ranged from eight to 2,539 acres per year in the immediately preceding 12 years and had exceeded 1,000 acres only in three years.

The yield-average this year was 14 bushels/acre (560 lb) and one commercial crop attained 1,900 lb/acre; whereas the yield-average over the 12 preceding years was 9.5 bushels/acre.

MEAT PRODUCTION

Only preliminary figures are available as yet. They indicate the following:

Beef and Veal

Production amounted to about 211,400 tons, compared to 244,530 tons in 1965-66. The 1966-67 production was the lowest since 1960-61.

High prices for beef cattle were a feature of the year. This encouraged the adoption of lot-feeding, to a limited extent in several parts of the State. Lot-feeding, widely practised in America, has hitherto been regarded as uneconomical in Australia but there are indications that it will expand if beef prices continue to increase.

Mutton and Lamb

Production amounted to about 173,100 tons, compared to 184,520 tons in 1965-66. The 1966-67 production was the lowest since 1958-59. Of course this reflected the drought-period.

Pig Meat, and Bacon and Ham

Production of pig meats other than bacon and ham totalled almost 37,660 tons, compared to 35,340 tons in 1965-66; whilst bacon and ham amounted to 15,700 tons, compared to 14,990 tons in 1965-66.

The number of pigs slaughtered during the year showed a significant increase on the previous year's figures, yet the quantity of pig meat produced showed only a slight rise. This was due to the higher proportion of pigs being slaughtered at lighter weights, for fresh pork. Consumption of fresh pork rose to a high level.

Production of bacon, though slightly higher than in the preceding year, barely met demand. Prices remained satisfactory.

Poultry Meats

The big expansion of the chicken meat industry developed in recent years, continued. Production, about 42,360 tons, showed a 40 per cent increase on the previous year. Almost all birds were produced under contract to processors.

Turkey production showed a 32 per cent increase on the previous year's figure.

DAIRY PRODUCTION

Factory butter-production in 1966-67 was 38,570 tons and factory cheese-production 5,000 tons. Butter output in 1965-66 was 32,990 tons and cheese 4,060 tons. Milk production by the State totalled 329,059,000 gallons, 22,044,000 gallons more than in 1965-66. In the Milk Zone it reached 159,353,000 gallons, 17,295,000 gallons more than in 1965-66.

EGGS

Egg production increased to a record 68,043,000 dozen, significantly greater than the 65,240,000 dozen in 1965-66. The trend to larger commercial farms continued.

HONEY

Production was low, mainly because beekeepers had to build up their hive-populations and restock many empty hives depleted during the previous year's drought. Because of less demand for Australian honey overseas, and satisfactory production in southern and western States, honey prices remained lower than desirable.

WOOL

First-hand deliveries of wool from the 1966-67 wool clip into the three main broker stores, Sydney, Newcastle, and Goulburn, totalled 1,310,955 bales during the twelve months ended June, 1967, compared with 1,236,446 in the previous twelve months.

Total receivals during 1966-67, including carry-over from the previous season and wool received for re-sale, were 1,396,221 bales; of these, 1,320,239 bales were sold. Total receivals in the previous twelve months were 1,362,344 bales; of these, 1,295,321 bales were sold.

After excluding 961 bales shipped overseas for sale, 75,021 unsold bales were held in store at the end of June, 1967.

Seasonal conditions increased the cost of production and a low wool market caused much concern. Sheep numbers were well below normal because of the drought and, in an attempt to recoup drought losses, a large wheat acreage was planted. Because of the swing to cereal production, there was no great demand for sheep for restocking and prices remained reasonable. Increased demand for crossbred ewes was apparent and, as a result, a number of Merino breeders (in particular on the central and southern slopes) commenced mating Merino ewes to Border Leicester rams.

STOCK NUMBERS

Sheep

At the end of March, 1967, the number of sheep and lambs in New South Wales was estimated at 63,800,000; some 2,400,000 more than at March, 1966, but still well below the record 72,400,000 in March, 1965.

Cattle

Cattle in New South Wales at the end of March, 1967, were estimated at 4,160,000, slightly above the March, 1966, figure but still considerably less than the March, 1964, record total of 4,789,000.

Pigs

The number of pigs in New South Wales was estimated at 516,000, the third from highest on record, exceeded only in 1944 and 1945. The March, 1966, figure was 480,000.

FRUIT AND ALLIED INDUSTRY

Citrus Record

Citrus output in 1966-67 was a record. The estimate of production is 5,900,600 bushels, much higher than the 1965-66 crop of 4,640,000 bushels, and largely influenced by the record Valencia crop of 1,346,000 bushels in the M.I.A. This M.I.A. volume of Valencias is likely to remain the norm.

A varietal break-up of the citrus production-total in 1966-67 is as follows: Navels, 1,601,500 bushels; Valencias, 3,493,000; Commons, 28,600; Seville, 18,500; lemons, 427,000; mandarins, 189,000; and grapefruit, 143,000 bushels.

There has been partial success in organization of citrus-marketing in New South Wales. Two Area Marketing Boards are being formed. One is for the Sunraysia districts of the New South Wales side of the Murray river, and it seems likely this Board will co-operate with a proposed Victorian board through the Sunraysia Districts Citrus Co-operative Society Ltd. A poll conducted in the Gosford-Wyong-Central Coast Districts was also successful, and grower-members are now being elected for this Central Coast board.

Pome Fruit Record

The 3,423,000 bushels of apples and 619,000 bushels of pears each comprised a record for this State. The records are not likely to stand for long, since at least one-third of the total acreage comprises trees under 10 years old—in good districts.

Stone Fruit Records

From 20,086 acres of stone fruit in 1961 the acreage in New South Wales has increased to almost 24,000.

Record production for canning peaches was established. Canning peaches harvested in the M.I.A. totalled 21,186 tons, as against 19,968 tons in the previous year, and production-average per acre was 5.9 tons.

Some 8,894 tons of apricots from irrigation areas went to canneries and a further 42,633 cases went to the fresh-fruit market. The total of 9,371 tons almost equalled the 1964-65 record of 9,422 tons.

The prune crop, over 5,000 tons (dried-weight) was a record.

Bananas

The downward trend in production continued. This year it totalled some 3,726,831 bushels; down about 128,800 bushels on the previous year's total. Eradication of unprofitable plantations is contributing to the trend. The acreage under bananas is 23,451; 274 acres less than in 1965-66. New plantings this year totalled 1,540 acres, in part offsetting the 1,814 acres destroyed for various reasons. Whilst the net decrease in acreage has been less than in 1965-66, the decrease trend continued.

Grape and Wine Industry Records

Record for Wine Grapes. Production for the 1967 vintage is estimated at 47,500 tons, considerably above the record of 41,839 tons set by the previous year.

Record Wine Production. Total wine production for 1967 vintage would also be a record, estimated at around 7,500,000 gallons as against the 6,425,674 gallons in 1966.

Record for Dried Vine-Fruits. The 14,951 tons (dried weights) established a record. In the previous year production was 11,929 tons. The break-up into types, for 1966-67, is as follows, in tons: Currants, 637; sultanas, 12,525; raisins, 1,738.

Lower Table-Grapes Production. 1966-67 production of table grapes was about 7,000 tons, compared with 7,699 tons in 1965-66, and well below the record 8,251 tons in 1964-65. The poor season for early table-grape districts, near Sydney, was one factor. Another factor was the increasing trend in the Murray districts to market sultanas as fresh fruit.

Notes on Fodder Conservation

By the end of June, 1967, the stored stock-fodder position was much improved, compared to 12 months earlier. Stored fodder was estimated to have increased by 40 per cent, in part because of the big increase in feed-grain.

HAY

Hay Production. This was estimated as a little over one million tons. Cereal and lucerne hay-production increased but pasture hay-production seriously decreased. The cereal hay increase reflected favourable weather in the spring of 1966, when record acreages were harvested. Lucerne was favoured by the spring and early summer rains. Grazing-utilization of pastures, and deterioration of some pasture areas, reduced the production of hay from this source.

Pelleting of Hay. Pellet-manufacture of stock feeds has proceeded for some time past but extra plants have been established during and since the drought. Lucerne with and without additives is being pellet-processed and this type of production seems likely to increase substantially in the near future. A small market has developed in other States and, also, some of the product is already being exported to Japan. Two firms plan to expand, to market pelleted fodder in "Far East" countries.

SILAGE

Production has been estimated as 140,000 tons. This would increase reserves to about 400,000 tons but that quantity would still be about 160,000 tons less than the 5-years average and the lowest for about 10 years past.

Previous reserves have been the effect of accumulation over long periods, from collection and storage in lush times. They were a major stand-by in the recent drought. Re-building of such reserves will be associated with the return of good seasons.

GRAIN

Wheat. The past year's record wheat harvest has provided a reserve to be drawn on if conditions deteriorate.

Oats. The oat harvest, estimated at 40 million bushels, comprised a record. Although the previous year yielded only 12.6 million bushels, growers' reserves are now at their highest level and will meet a large proportion of stock needs in the 1967 winter and spring.

Maize. The 1967 crop is still being harvested and expected to yield some 2½ million bushels; an increase of about 100,000 bushels over the previous crop. Some may be exported to Japan but most will be used as stock-feed.

An interesting increase is occurring in the northwest and southwest. Much of the increase in the northwest seems likely to be used with cotton-seed meal as a fattening ration for cattle and pigs.

Barley. Production has been estimated as 12 million bushels; at least 8 million more than in the previous year. Most of the increase will be available as stock-feed.

General Increase in Grain Storage. An increase by more than 100 per cent in production of grains suitable for stock-feed has been apparent, without taking into account what may be available from the record wheat harvest. But there is scope for far greater attention to storage of grain, not only for drought-feeding but for supplementary-feeding during temporary pasture-shortage periods.

GRAIN DRYING

This year there has been a lot of activity amongst farmers and machinery firms in respect of grain drying, centred mainly in the wheat industry. Demand has developed for a small, mobile cold-air drier, capable of drying wheat from 14-15 per cent moisture down to the Grain Elevators Board's

standard of 12 per cent. Several machinery firms are developing such machines, with a 3-5-hp diesel motor. Some permanent installations are being built into existing sheds and silos, and some new whole-units are being constructed.

Grain drying largely eliminates the hazards of unfavourable weather at harvesting and can thus reduce the harvest period.

Moreover, grain harvested with 15-16 per cent moisture content is less liable to crack at harvesting and grain quality may thus be improved. Accompanying the trend to drying, many farmers now have moisture-meters to test the grain.

So far there has not been much coastal nor tablelands demand for grain driers, but maize and grain sorghum could benefit greatly from them.

Two large machinery firms active in adapting grain driers to suit Australian wheat-belt conditions, claim considerable advances in constructing mobile machines which can be fitted to header bins, field bins, and temporary paddock-storage facilities. A system of pre-heating air by drawing it over the diesel motor before it enters the grain has been developed, thus increasing the efficiency of drying.

HIGH-MOISTURE GRAIN STORAGE

Two firms have imported equipment enabling storage of high-moisture grain. The system, ideal for storing feed-grains, has only limited use if the grain is for human consumption or seed. Whilst it has little application on wheat farms, it could be of value in coastal and tablelands storage of maize.

FODDER SPECIALIST'S STUDY TOUR OVERSEAS

The Department's Special Agronomist in Fodder Conservation, Mr F. A. York is presently overseas for three to four months—visiting the U.S.A., Canada and U.K. to investigate and study developments in fodder conservation practices.

Notes on Fertilizer Industry Trends

The structure of the fertilizer industry is rapidly changing. Today, far-removed from the relatively simple operation of providing single-strength superphosphate and sulphate of ammonia, it is a processing- and distributing-complex providing a great range of high-analysis and other fertilizers.

The industry appears to be becoming more geared to a manufacturer-dominated distribution and fertilizer-spreading system. The major fertilizer manufacturer and distributor in N.S.W. has already set up bulk-storage facilities for superphosphate and anhydrous ammonia in many country centres.

Bulk-handling continues to increase. Of the 785,000 tons of superphosphate used in the recent 12 months (actually to September, 1967), about 70 per cent was handled in bulk.

Effects of the drought are still being reflected in fertilizer use but even so the upward trend in quantities used has continued, particularly the use of nitrogen. Anhydrous ammonia usage increased from 1,000 tons of nitrogen in 1965-66 to over 3,000 tons in 1966-67. Use of aqua ammonia has decreased, from about 500 to 250 tons. Use of urea has also decreased further during the past 12 months.

Sulphate of ammonia usage has increased from 12,500 to at least 14,000 tons. This usage figure might even be higher, as stocks of sulphate of ammonia held on farms since just prior to the drought have no doubt also been used during the period under review.

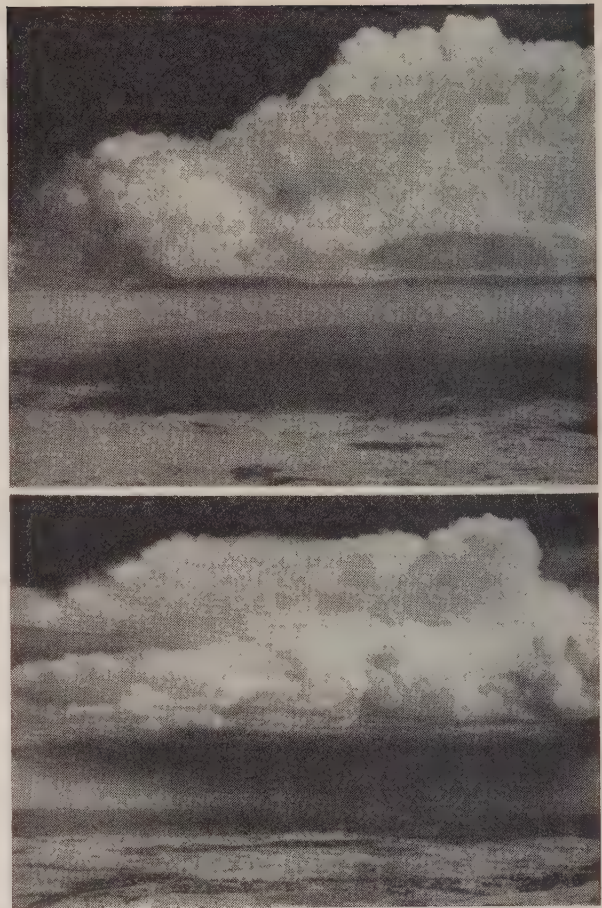
There is a growing demand for potash fertilizers but consumption is relatively low.

High analyses fertilizers are continuing to gain in popularity. Their usage increased from about 25,000 tons in 1965-66 to 60,000 in 1966-67.

Superphosphate usage increased from 610,000 tons to 775,000, from N.S.W. production sources, and it has been estimated that another 150,000 tons came from Victoria and Queensland sources.

Use of double superphosphate continued to rise. It increased from 10,000 to 40,000 tons.

Departmental research into wheat-nutrition needs has expanded considerably in main sections of the Wheat Belt. The work has led to marked increase in usage of superphosphate by wheat growers, and has also alerted growers to the need to apply nitrogen as well as superphosphate in special circumstances on certain soil types.



The Cloud-seeding Project (see pp. 12 and 13)

Top. Cumulus cloud before it was seeded. Bottom. Cumulus cloud raining, some 30-40 minutes after it was seeded

A Departmental Committee this year collaborated in the re-drafting of the Fertilizer Act to bring it into line with scientific advances and the changes in marketing practices which have occurred since the Act was passed in 1934. The new Fertilizer Bill has been passed by both Houses of Parliament. Regulations for its implementation are to be drafted before it is proclaimed.

The Bill imposes on the fertilizer vendor a duty to disclose, by invoice certificate and label, certain particulars including the fertilizer's weight and the proportion of potassium, nitrogen or phosphoric acid. It brings the labelling into line with modern trade needs. The amendments will definitely assist farmers and agriculture generally, without any undue inconvenience to the manufacturers.

Notes on Cloud-Seeding

The Department has co-operated with the CSIRO in cloud-seeding experiments for many years and since May, 1965, has been engaged in seeding operations using silver iodide over drought-declared areas and the dam catchments serving drought areas. The CSIRO considered that research results were sufficiently encouraging for the State to commence large-scale cloud-seeding. This development, of State responsibility for application of research findings, is consistent with accepted procedure whereby CSIRO basic-research work is later field-tested by State Departments.

New South Wales has been the leader in the field of large-scale cloud-seeding in the Commonwealth. During the year under review Victoria and Western Australia have followed this lead and undertaken cloud-seeding operations to increase rainfall.

Because of the worsening drought situation, the Department this year chartered a second aircraft. It commenced operations at Dubbo on 15th August, 1966. An officer of the Forestry Commission, with some cloud-seeding experience, was seconded to the Department of Agriculture to operate in the second plane until a second Department of Agriculture officer (Mr J. Mahon) could be trained.

In December, 1966, the plane based on Dubo was transferred to Cobar, as the drought situation had eased in most of the State except the Western Division. Moreover, farmers in the wheat belt required dry conditions for harvesting.

As the whole of New South Wales was again in a potential drought situation in May, 1967, the scope of the Department's cloud-seeding operations was extended to include "Potential Drought Areas". The plane based on Tamworth was accordingly transferred to Wagga to seed in southern areas of the State.

In May, 1967, the Public Service Board approved appointment of two Cloud Seeding Officers. Cloud-seeding was previously done by officers who were agronomists-in-training for Extension Services.

To determine the success or otherwise of cloud-seeding done by the Department is very difficult. This is particularly so during the winter when operations are performed in strata-form clouds where visual assessment is almost impossible. During the summer, cumulus formations are dominant and visual assessment of the effect of seeding such clouds is often possible. Visual assessment is in any case unacceptable to the biometricians, but observations do indicate that seeding has made a worthwhile contribution.

Cloud-seeding is an entirely new field of work in this country. When it is realized that a one per cent increase in precipitation would pay for the cost of the whole operation in a hydro-electric region, and that for an Agricultural Region the relevant figure would be less than 4 per cent, the potentially tremendous influence of successful cloud-seeding on the future of agriculture in this country is apparent.

For the record, this year's statistics for one plane's activities are as follows: flew on 180 days during the 12 months; seeded on 94 days; was in the air 664 hours, and was seeding for 250 hours.

Notes on Some Committees, Councils, Trusts

STANDING COMMITTEE ON DROUGHT RELIEF

The Inter-Departmental Standing Committee on Drought Relief, established in May, 1965, by the Cabinet Subcommittee on Drought Relief, and under the chairmanship of the Department's Chief of Regional Extension Services, met on three occasions this year. The Committee reported direct to the Minister for Agriculture on matters referred to it and also made recommendations for variation or introduction of drought-relief schemes.

The following major schemes were still in operation at the end of June, 1967:

Advances for Drought Relief. Under this scheme, \$6,000 at 3 per cent interest, repayable over seven years, is loaned to primary producers in necessitous circumstances, for "carry-on purposes". The scheme provided also for further loans, to a maximum of \$12,000, in special circumstances. So far over \$11,500,000 has been loaned to eligible farmers since inception of this scheme in November, 1965. Almost 2,900 landholders have received the assistance.

Re-stocking Scheme. This provides a maximum advance of \$10,000, at 3 per cent interest, repayable over seven years, to purchase replacement stock. Over \$400,000 has been loaned under this scheme which commenced in April, 1966, and 66 landholders have participated.

Road Transport Subsidies. Subsidy schemes apply to road transport of fodder and stock within the Western Division. The subsidy is 5 cents per ton per mile for fodder, 10 cents per 50 head per mile for sheep, and 10 cents per 5 head per mile for cattle. Subsidies exceeding \$93,000 were granted during 1966-67.

Rail Freight Rebates. These apply to fodder carried by rail for use by stock in declared drought districts, and to livestock carried by rail to or from agistment.

Declared Drought Areas. At 1st July, 1966, thirty-eight Pastures Protection Board Districts were "Declared Drought Areas". The declarations increased to 41 in August but fell to 23 in October, 1966, and to six by January, 1967; reflecting the improved pastoral situation. Then, because of lack of effective general rain over the State in late summer and autumn, the number of Declared Drought Areas had gradually climbed to 18 by June, 1967.

These 18, mainly Western Division districts, and a number in the southwestern quarter, comprised some 40 per cent of the State's area despite the favourable numerical comparisons provided by the fact that in June, 1965, there were 44 and in June, 1966, there were 38 Declared Drought Areas.

FLOOD AND BUSH FIRE RELIEF COMMITTEES

The Chief of Regional Extension Services and the Accountant of the Department of Agriculture are members of the N.S.W. Flood and Bush Fire Relief Committees.

The Flood Relief Committee in the six months to 30th June, 1967, examined over 700 claims for relief, and grants made to 626 applicants totalled \$65,735.

Floods, particularly on the north coast, involved regional officers in damage inspections, claim checkings, and reporting. The Chief of Regional Extension Services devoted considerable time to relief schemes as a direct essential link for the Committees with the Departmental field staff's local knowledge and basic information.

THE AUSTRALIAN AGRICULTURAL COUNCIL AND STANDING COMMITTEE ON AGRICULTURE

Two meetings of the Australian Agricultural Council and Standing Committee on Agriculture were held during the year, the first in Perth in July, 1966, and the second in Melbourne in February, 1967. Numerous items of importance to agriculture and organization were discussed and subject of decisions.

THE ROYAL BOTANIC GARDENS AND GOVERNMENT DOMAIN TRUST

Meetings of the Royal Botanic Gardens and Government Domain Trust were held on three occasions during the year. Trustees requested that the Director-General of Agriculture should act as Chairman of future meetings in the absence of the Minister for Agriculture.

Matters dealt with this year included: remodelling of the Domain Baths; final stages of construction of the Sir Leslie Morshead Memorial Fountain; restoration of the pumping and reticulation system for the Captain Phillip Fountain; restoration of the one-way traffic road from Art Gallery along Mrs Macquarie's Road; lease of the Kiosks in the Botanic Gardens and Government Domain; space for extensions to the Art Gallery of N.S.W.; and maintenance of the surrounds of the Cahill Expressway.

THE FARRER MEMORIAL TRUST

Two ordinary meetings and the Annual Meeting of the Farrer Memorial Trust were held. The Director-General of Agriculture agreed to act as Chairman of the Trust, following the retirement of Dr Grahame Edgar.

Approval was granted for Mr L. A. Douglas, 1966 Farrer Memorial Scholar, to accept the offer of a Student Assistantship at Iowa State University, enabling him to work under Dr Bremner. Extension of Mr Douglas' Scholarship for a further period of 12 months was also approved.

The 1967 Farrer Memorial Medal was presented to Professor E. J. Underwood, Director, Institute of Agriculture, University of Western Australia, at a special session of the ANZAAS Congress in Melbourne, on 17th January, 1967. Professor Underwood delivered there the 1967 Farrer Memorial Oration—"Man, Land and Food".

The Farrer Memorial Medal for 1968 has been awarded to Dr E. M. Hutton, Director, Cunningham Laboratory, University of Queensland. The Medal will be presented to him at the University of Sydney in March, 1968, at a function to be organized in association with the Australian Institute of Agricultural Science.

Finance—Summary

Consolidated Revenue Fund Expenditure and Receipts. Expenditure from Consolidated Revenue Fund was \$13,863,340. This included \$2,250,627 for cattle tick control and \$506,184 for the upkeep of the Royal Botanic Gardens and Admiralty House; in part recouped by the Commonwealth Government.

Details of Consolidated Revenue Fund expenditure by other Government Departments on behalf of the Department of Agriculture are shown in the Public Accounts, tabled in Parliament as an accompaniment to the Report of the Auditor-General.

Receipts from all sources totalled \$2,601,104 and are shown in some detail later in this Report (*Appendix I*—"The Accounts of the Department of Agriculture—1966-67").

Capital Works. Capital works to the value of \$334,499 were constructed from Loan funds, and details are in *Appendix I*—"The Accounts of the Department of Agriculture—1966-67".

Trust Funds. The provision of funds by industries, semi-government bodies, Commonwealth Government grants and specialized taxations continued to show the upward trends apparent in recent years. Substantial sections of the research programmes have been financed by these means (*vide* later paragraphs: "Industry Funds for Research"), and findings have been extended to the primary producers and others with the help of special Commonwealth grants (*vide* later paragraphs: "Commonwealth Grants for Extension Services").

Expenditure from such grants or trusts is handled through the "Special Deposits Accounts" at the Treasury and regulated either by Act of Parliament or by such directions as may be given by the donor body, to whom the Department of Agriculture must account at the close of each financial year.

Some of the more important aspects of the operations on the Special Deposits Accounts are given in *Appendix I*—"The Accounts of the Department of Agriculture—1966-67".

Commonwealth Grants for Extension Services

Substantial increase in funds under the Extension Services Grants was made by the Commonwealth during 1966-67, the increase being \$222,800 and the consequent total \$547,800.

Under the initial Grants (Dairy Industry Extension Grant \$175,000, and Agricultural Extension Grant \$150,000) funds totalling \$325,000 were provided, for: salaries and travelling expenses for such personnel as publicity and liaison officers, agricultural machinery officers, display and design artist, milk-

ing-machine survey officers, field assistants, packing instructor, certain herd recording staff, college and university trainees, and expenses connected with overseas study-tours; running and repair costs of vehicles purchased from Grant funds, and replacement vehicles; purchase of a wide range of equipment including an infra-red milk analyser (\$10,400) installed at Hawkesbury Agricultural College, mobile cattle-scales, film- and slide-projectors, cameras, soil samplers, water- and soil-testing apparatus, reference books; printing and production of several books, publications and coloured leaflets on insect pests and plant diseases; and the purchase of a variety of materials and equipment for farm demonstrations.

The two Grants will be combined as from 1st July, 1967, to be known as the Commonwealth Extension Services Grant (C.E.S.G.). The former projects, under the old Grants, will be integrated with those under the new Grant.

Proposals for expenditure of over \$1 million of C.E.S.G. funds in the 1967-68 fiscal year have been prepared for submission to the Commonwealth.

Industry Funds for Research

1965-66 AND 1966-67 COMPARISONS

The following are comparative statistics showing the monetary support for Department of Agriculture research during the past two years from the various Industry Research Funds.

Source	1965-66		1966-67
	Allocated	Expended	Allocated
	\$	\$	\$
Wheat Industry Research Committee	84,760	72,138	47,130
Wheat Industry Research Council	37,252	26,105	47,302
Wheat Industry Stabilization Fund	102,130	74,285	84,355
	(incl. unexpended balance from 1964-65)		(incl. unexpended balance from 1965-66)
Wool Research Trust Fund	80,440 +	84,953	107,288
Australian Meat Research Committee	98,884	68,086	82,910
Australian Dairy Produce Board	103,778	62,246	67,158
Tobacco Industry Trust Account	58,100	19,542	67,630
			(incl. \$21,550 set aside for Ashford Tobacco Research Station)
Totals	565,344	407,355	503,773

In 1966-67, funds from the *Wheat Committee* were reduced to \$47,000, about half, due to the drought. This led to cancellation of three previously approved research appointments. On the other hand there was an increase of \$10,000 in *Wheat Council* allocations, the drought having not reduced wheat yields greatly in some of the other States.

In the case of Meat Research, approval for two appointments which had not been filled were withdrawn.

For 1967-68, funds from the *Wheat Committee* were increased—to nearly \$86,000 and *Wheat Council* allocations increased to \$97,000 due in part to the record Australian wheat crop. Funds from the Meat Committee were reduced to 90 per cent of the 1966-67 allocation and this will probably be so for three seasons—reflecting the long term effect of drought on cattle and beef slaughterings.

The examples provided by the preceding paragraph illustrate a problem associated with use of Industry funds: their variability from year to year, influenced by seasonal conditions, and the fact that conditions affecting availability of the funds may not be uniformly good or bad in all States. The latter point is illustrated by the 1966-67 allocation respectively from the *Wheat Committee* (State) and the *Wheat Council* (Commonwealth).

The phenomenal Australian wheat harvest of 1966-67 was reflected in the total allocation of more than \$1,000,000 to research organizations by the *Wheat Industry Research Council*. This total was achieved after providing a reserve of over half a million dollars.

ALLOCATIONS FOR INDIVIDUAL RESEARCH PROJECTS

The following projects were supported by Industry funds during 1966-67 and to the extent shown by the figures in parentheses.

Wheat Industry Research Committee Funds

Wagga Agricultural Research Institute Projects. Agronomic Survey Unit (\$12,984); Skeleton Weed (\$400); Breeding of Improved Varieties for Irrigation (\$5,422); Improved Pastures re Soil Fertility (\$1,510).

Tamworth Agricultural Research Station Project. Legumes in relation to soil productivity (\$2,800).

Central West Projects. Wheat Research (\$24,014).

Wheat Industry Research Council Funds

Tamworth Agricultural Research Station Projects. Improvement of Durum Wheat (\$7,980); Frost Resistance (\$2,194); Hybrid Wheat (\$3,176); Growth Analysis (\$10,380); Manufacture of New Cereal Header (\$3,900); Seed Counter for Durums (\$1,100).

Division of Science Services, Rydalmere Project. Yellow Dwarf Virus (\$400).

Division of Marketing and Agricultural Economics Project. Economics of Segregation and Storage of Wheat (\$5,860).

Wagga Agricultural Research Institute Projects. Critical Levels of Soil Nitrogen (\$7,312); Overseas Travel—E. G. Cuthbertson (\$2,500); Overseas Travel—A. N. Smith (\$2,500).

Wheat Industry Stabilization (Disposal) Fund—Progress Amounts

Wagga Agricultural Research Institute Projects. Soil Phosphate Tests (\$29,983); Environment Controlled Cabinets (\$8,000); Drought Resistance Wheat Varieties (\$14,071); Overseas Visit—G. M. Halloran (\$145).

Tamworth Agricultural Research Station. Mobile Equipment (\$13,853); Control of Weeds in Field Crops (\$5,320); Cereal Chemistry Research Unit (\$22,658); Controlled Environment Equipment (\$16,550).

Central West Project. Wheat Research (\$15,823).

Wool Research Trust Fund

Division of Science Services, Rydalmere Project. Insecticide Resistance in Sheep Blowflies (\$6,600).

Graman District Project. Black Soil Scarab (\$140).

Bathurst Agricultural Research Station Projects. Serrated Tussock Control (\$800); Aerial Control of Serrated Tussock—Southern Tablelands (\$2,000).

Shannon Vale Project. Sheep Breeding and Pasture Management—relative efficiency at several stocking rates and super-phosphate levels (\$12,500).

Trangie Agricultural Research Station Projects. Fleece Measurement for Selection of Stud Merino Rams (\$15,750); Comparison of two Management Systems (\$3,340); Investigations of Vital Statistics of Yass Valley Merino Flocks (\$8,100); Efficiency of Wool Production (\$6,020); Comparison of Single and Twin Born Merino Ewes (\$1,700); Productivity of Natural Annual Pastures (\$9,320); Ram in Flock, Reproductive Performance (\$500).

Temora Agricultural Research Station Projects. Stocking and Super Applications re the Productivity of Merino Ewes Grazing Improved Pastures (\$640).

Wagga Agricultural Research Institute Projects. Effect of Pasture Management and Time of Lambing on Wool and Lamb Production in the South-West Wheat Belt of N.S.W. (\$400).

Goulburn Project. Adaptive Pasture Research, Southern Tablelands (\$10,850).

With CSIRO; Canberra Projects. Development of High Rainfall Region of Southeast Australia (\$5,016); Study of Factors Limiting Pasture Yield (\$5,432); Physiology of Pasture Seeds (\$4,866); Study of Some Factors Influencing Efficiency of Rhizobia (\$5,870); Aerial Sowing of Pastures (\$5,016); Forage Ecology—Research Agronomists (\$2,428).

Australian Meat Research Committee Funds

Grafton Agricultural Research Station Projects. Beef Feed Year Research—North Coast (\$25,790); Determination of Available Phosphate Levels (\$13,050).

Tamworth Agricultural Research Station Projects. Diagnosis of Element Deficiencies in Soils (\$3,820).

Leeton Agricultural Research Station Project. Pasture Intake and Digestibility Studies (\$3,280).

Glen Innes Agricultural Research Station Project. Winter Nutrition—Northern Tablelands (\$9,400).

Division of Marketing and Agricultural Economics Project. Nature and Organization of the Beef Cattle Industry (\$5,450).

Trangie Agricultural Research Station Project. Beef Cattle Breeding Improvement (\$6,000).

Division of Science Services, Rydalmere Project. Inoculum for Summer Legumes (\$2,200).

Glenfield Veterinary Research Station Projects. Incidence, Importance and Control of Parasites of Cattle in N.S.W. (\$8,320); Epidemiology and Control of Fluke Parasites of Cattle in N.S.W. (\$3,600).

At University of New England, Armidale. Bloat Research Project (\$2,000).

Australian Dairy Produce Board Funds

Wollongbar Agricultural Research Station Projects. Socio Economic Investigations (\$15,000); Pasture Species Research (\$12,276); Other Pasture and Animal Research (\$20,262).

Mooneba Project. Flood Irrigation Research, at Mooneba (\$1,120).

Pasture Improvement (Committee) N.S.W. (\$3,500).

Hawkesbury Agricultural College Projects. Recombining Unit (\$5,000); Manufacture and Keeping Qualities of Process Cheese (\$1,620); Seasonal Variations of Skim Milk on Physical and Chemical Qualities of Spray-dried Skim Milk Powder (\$8,380).

Australian Apple and Pear Board

Entomology Branch. Management in Pome Fruit Orchards (\$8,950).

Banana Research Advisory Committee Funds

Alstonville Tropical Fruit Research Station. Banana Research (\$5,550).

Research Liaison Office now Research Administration Office

CHANGE IN RESPONSIBILITIES

The former Chief Research Liaison Officer position (Dr S. L. Macindoe) has been redesignated and increased in status to Chief of Research Administration. A new position of Executive Assistant (Mr K. E. Hutton) to the Deputy Director-General (Research and Education) also has been created. The latter will effect a release of the Chief of Research Administration from certain of the responsibilities that arose in the former "Chief Research Liaison Officer" position—in particular detailed handling of Industry Research Fund matters.

Establishment of the Chief of Research Administration position reflects the expansion and increasingly important role of Departmental research. It also reflects an overall programme to develop decentralized major research units.

In general it has been agreed that the principle of appointing research leaders to Stations with sufficiently numerous research staff shall be further pursued and that other Stations will be viewed as Sub-stations. Building of larger regional research centres at the major Research Stations is the intention. Definition of the role of each of the 23 Research Stations controlled by the Department is proceeding. The policy coincides with the summarized statement from the Seminar on Regional Research in 1966 (see last year's report) held at the University of New England. In part the statement was as follows:

"The production and economic efficiency of Australian agriculture and the economic and social progress of Australia will be greatly increased by a system of viable decentralized regional research and development centres at strategic sites in agro-ecological areas. In many cases the centres would be developed by the extension, improvement, and co-ordination of existing facilities. The prime responsibility of such centres would be to mobilize and direct knowledge with the object of improving economic and social progress and achieving rational short and long term land policies."

INTEGRATION AND REVIEW OF RESEARCH

Special statements and instructions were issued this year, dealing with "integration of research work undertaken on regional Stations" and others dealing with procedures for "research projects involving the management of grazing live-stock". These statements and instructions supplemented the normal procedures for "approval and review of research projects".

Review of the research programmes, of individual research workers, has virtually been completed. Future procedure will comprise periodic examination of the research programmes of research units (i.e., Stations/branches) rather than individuals. Such examinations should be undertaken by a select committee, preferably including some representation of research workers from outside the Department.

Action is proceeding now towards appointment of a Research Review Committee to consider the work in progress at the Agricultural Research Institute, Wagga Wagga. This Committee is likely to set a pattern for the review of other Research Stations and branches.

NEW PROJECTS REGISTERED IN 1966-67

Thirty-seven new research projects were registered during 1966-67, as follows.

Division of Animal Industry

A Study of Pesticide Residues in the Egg of the Domestic Fowl; Inactivated Infectious Laryngo-tracheitis Vaccine in Tamworth Area; Definition Study of Weaner Growth—Shannon Vale Nutrition Station; Studies on the Controlled Breeding of Ewes Using Progestagen Impregnated Intravital Sponges; Cottonseed Meal in Laying Diets; Fishmeal and Unidentified Growth Factors in Chicken Diets; Poultry Husbandry and Environment Experiments; Experiments Using the Lustre Mutant Merino; Turkey Husbandry Projects at Wagga Agricultural College; Nutritional Investigations for Commercial Interests; Evaluation of Dry-land Grazing Lucerne in Terms of Plant and Animal Products; Maintenance Feeding of Sheep with Increased Wool Growth.

Division of Science Services

Entomology. Survey of Insects and Mites on Pome and Citrus Trees; Pest Management in Pome Fruit Orchards; Potato-Moth—Control by Parasites; Clover Root Weevil (*Amnemus* spp.)—Resistance of Pasture Legumes; Control of Seed-harvesting Ants.

Chemistry. Thermodynamic Equilibria Studies in Relation to Soil Potassium; Zinc Deficiency in Maize and Other Crops; Soil Survey—Orange Agricultural Research Station.

Division of Horticulture

Comparison of Dwarfing Budlines on Trifoliata; Grapefruit Variety and Rootstock Trial; Dwarf Citrus Trees—Effect of Rootstock; Gordo Blanco—Selection Trial; Gordo Blanco—Rootstock Trial; Effect of Chloride on Citrus Trees.

Division of Plant Industry

Cereal Crop Management Trial; Mineral Nutrition of Pastures in the Richmond-Tweed Region; Pasture Utilization and Animal Production Research—Trangie Agricultural Research Station; Native Pasture Research—Narrabri Agricultural Research Station; Pasture Utilization and Animal Production Research—Temora Agricultural Research Station.

Division of Marketing and Agricultural Economics

The Demand for Water in Cotton Production.

Division of Dairying

Cold Cleaning of Milking Machines Using Foam; The Microflora of the Milking Machine.

Agricultural Research Institute, Wagga Wagga

Perennial Grass Trial; Weed Types, Weed Levels and Crop Yields; Critical Levels of Soil Nitrogen in the Southern Wheat Belt.

External Studies: Overseas and in Australia

A review has shown that during the five years 1962-66 inclusive, 58 officers were overseas either for post-graduate studies, special-purpose assignments, or international congresses/conferences.

At present 10 officers are overseas on post-graduate study-leave, 10 others are overseas or about to depart for official purposes, and 18 are doing post-graduate work at various Australian universities or with the CSIRO.

Twenty-eight of the 38 accounted for in the preceding paragraph are research workers and comprise 11 per cent of the Department's research staff. The percentage compares well with that of the universities. The latter at any one time have about 10 per cent of their permanent academic staff overseas on visits or special assignments.

Appendix IV shows some details of officers' overseas visits in the past year.

Automatic Data Processing Section (A.D.P.)

The A.D.P. Section for Herd Recording was further developed. It now provides for herd owners' information and for press use printed monthly reports of production in the Official Section of the Herd Recording Scheme, also processing of goat records, printing of extra statistical tables, and simplified collection and preparation of data.

Ten officers were trained in programming and 12 others undertook A.D.P. orientation and induction courses. Talks on A.D.P. and computers and their use in agriculture were given to officers at Rydalmere, Tamworth, Yanco and Griffith.

Exploratory studies into a number of possible new A.D.P. applications were commenced. These included: citrus leaf analysis (Chem. Branch), beef cattle performance recording (Div. of Anim. Ind.), and stock medicines registration (Div. of Anim. Ind.).

The computer was used also to produce lists of wheat growers, the lists to be used for printing preliminary Rolls of growers for a poll to elect representatives to the N.S.W. Grain Elevators Board.

Some Notable Developments

CONCERNING LIVESTOCK INDUSTRY

Projected District Veterinary Laboratory for North Coast

A site for a District Veterinary Laboratory to serve the North Coast Area has been selected at Wollongbar Agricultural Research Station. A contract for the construction has been signed. The laboratory should be in operation early in 1968. This will be the second such District Veterinary Laboratory. The other is functioning at Armidale, and a report of some of its activities is under "DIVISION OF ANIMAL INDUSTRY".

Sheep-Blowfly Tolerance to Organophosphorus Insecticides

Tolerance by sheep blowflies to organophosphorus insecticides doubled during the last blowfly season. Studies indicate that these insecticides still provide protection from flystrike, but with shortened period of protection. In the course of the tolerance-survey, a single case of pre-existent tolerance to a carbamate was established.

Quarantine Actions against Possible Disease Entries

In administration of the Quarantine Act on behalf of the Commonwealth Government, a serious problem continued to be set by the illegal importation of food and other material of animal origin which could carry into Australia the causal organisms of serious livestock diseases not in this country. The baggage of many passengers arriving by air and sea was found to contain quantities of materials such as salami, cheese, egg noodles and other foods.

Bovine Tuberculosis

Five more Quarantine Areas wherein the testing of all cattle is compulsory were gazetted during the year. This brings to 75 the total of such areas.

Cattle tested during the year totalled 761,677. Overall incidence of reactors increased from the 0.19 per cent in the previous year to 0.29 per cent; due largely to finding a higher level of infection in new areas, tested for the first time, than in similar areas tested in the previous year, and also to an increase from 0.83 to 1.21 per cent of reactors detected in retests. There was an increased number of herds wherein there was a high level of infection despite negative results to previous herd tests. This was despite no apparent means whereby the disease could have been introduced.

The proportion of reactors wherein tuberculosis lesions were not detected on slaughter increased, from 30 per cent in the previous year to 32.9 per cent this year.

Brucellosis

An extensive survey to assess the incidence of the disease with a view to possible eradication measures was undertaken in the Hunter River Valley. Milk-ring tests were applied to the bulk milk of some 2,700 suppliers at 11 milk depots and butter factories. The positive reactions recorded at different factories indicated infection in the herds of from 20 to 52 per cent suppliers, with a mean of about 37 per cent.

Western Division Public Watering Places

Implementation of the programme for repair and maintenance of watering facilities, and provision of new Public Watering Places, in the Western Division, was speeded this year by expenditure of \$135,000 for the purpose. It followed expenditure of \$152,000 in 1965-66. The programme has been subject of very favourable comment.

Dairy Farm Feed-Year Assistance Scheme, North Coast

The most significant development for the dairying industry in the past year has been the Government's introduction of the North Coast Feed-Year Assistance Scheme. There is detail of the nature of the Scheme and its acceptance by the dairy farmers in this Report, under "DIVISION OF DAIRYING" and "DIVISION OF PLANT INDUSTRY".

The Scheme started to operate in October, 1966, and some 3,005 dairy farmers, at least 50 per cent of the total eligible, were participating in it within the first nine months of its operation. It has been estimated that the number of participants will reach 4,500 by the end of 1967.

One notable result so far has been the extension from the normal length production period in the autumn months, and adequate proof that the production average per cow has been increased. The Scheme seems destined to provide a far greater stimulant to efficient farm production on the north coast than any previous measure.

Continuous Butter-making Machines

Four continuous-units are now operating commercially in Australia, and producing butter of the desired quality, body and texture.

Officers of the Division of Dairying have been active in trials conducted with the one, imported from overseas, so far installed in New South Wales. This is in the Norco factory, Lismore. It is already apparent that this type of unit will replace existing, orthodox churns as the latter become too costly to service.

Dye-Markers in Antibiotics; for Dairy Industry

The Department has had a leading role in the development of methods of usage of dye-markers, in veterinary preparations of antibiotics for control of mastitis in dairy herds; and the adaptation of methods to detect antibiotics in market milk.

Research is being continued to clarify anomalies encountered; also on the effect of high dosage rates, and formulation, on delayed excretion of antibiotics.

Legislation now requires specific dyes to be in all formulations except where veterinary prescriptions to the contrary have been issued.

CONCERNING FIELD CROPS AND PASTURES

New Wheat and Oat Varieties Released

A new wheat and a new oat were named and released following successful Departmental work.

The wheat variety is Robin, bred at the Agricultural Research Institute, Wagga. It is a soft wheat, of the Heron type, and has yielded appreciably better than Heron.

The oat is Coolabah, bred at the Temora Agricultural Research Station. It is early-maturing, suitable for light grazing and grain. Coolabah could replace Fulghum, a variety grown for many years past in New South Wales.

The New Rice Variety "Kulu"; Bred Here

The rice-breeding programme at Yanco Agricultural College and Research Station achieved a most notable objective in the release and naming of the long-grained variety—Kulu.

Kulu has attracted world-wide interest and, in the past twelve months, forty-five requests for seed have been received from twenty-five countries.

This release comprises a twofold achievement. Firstly, Kulu is the first rice variety to be developed in New South Wales from a cross-breeding programme. Secondly, Kulu combines a long and fine-shaped grain with a yielding ability previously considered by rice-breeders throughout the world to be unattainable with long-grain types.

Yield under commercial conditions in the past season was comparable with the long-established short-grained varieties. The Kulu crops averaged 2.5 to 3 tons per acre, comparable

with the 3 tons per acre average for Caloro and Calrose. The "interim-grown" long-grained variety Bluebonnet 50 averaged 1.6 tons per acre. This too draws attention to Kulu's remarkable performance.

More Rice Records

The 1966-67 rice crop created four new records—total planting, total production, yield-average for the entire plantings, and yield-average for a single commercial sowing.

The total area sown was 73,820 acres; the previous record was 64,154 acres in 1965-66. The record harvest totalled 210,939 tons; the previous record was 178,873 tons in 1966.

Of more significance was the new record established for the yield-average of the entire sowing; 2.86 tons per acre. Previous records were 2.79 tons per acre in 1966 and 2.64 tons per acre in 1959. The new record places Australia even more firmly as the foremost "rice-yield per acre" country.

The fourth record was yield-average for a single entire crop; 4.49 tons per acre, over a 60-acre crop. The previous record was 4.46 tons per acre, in 1966.

Continued improvement in the efficiency of the New South Wales rice industry has been largely due to the active co-operation between the Department and rice industry organizations over the years. The highly successful research and extension programmes have been aided by ready and rapid acceptance of results by growers and growers' organizations, and by the industry's financial contributions towards research.

The New South Wales rice industry has become one of the most efficient and important in the State. Total returns to growers from the 1967 harvest will approximate \$12 million. After processing, near to 80 per cent of the crop will be exported.

Cotton Acreage Expectation Affected by Drought Effect on Water Storages

Between 1963 and 1966, cotton plantings in New South Wales expanded rapidly from 2,000 acres to 34,000 acres, with associated increase in production of raw cotton from 2,000 to 69,000 bales. At this point the State contributed 75 per cent of the total Australian production of raw cotton.

Intended plantings for 1966-67 were estimated at 40,000 acres, with 80,000 bales production potential. However, the northern drought conditions led to an extremely low level of stored water in Keepit Dam and this restricted to 27,500 acres the plantings in the Namoi Valley. Final plantings for the State as a whole were reduced accordingly; to an estimated 30,400 acres. A large proportion of the cotton was late-sown because of the conditions and there was associated reduction in yield per acre. The production ultimately was estimated as 52,500 bales.

Collaborative Cotton Research with CSIRO

The cotton-growing industry has developed here at a rate rarely observed in Australian agricultural industries. Because of the lack of research data, and the relatively few officers engaged in cotton research, a co-ordinated approach to the solution of cotton production problems has been consolidated. Collaborative research, between this Department and the CSIRO, has been initiated. A Joint Research Committee, and Working Parties on breeding, soils and nutrition have been established.

Sub-tropical Pasture Species and the Feed-Year Concept

Sub-tropical grasses and legumes have invited controversy on the north coast. There have been disappointing drought years, establishment failures and management failures, and severe attacks by weevil pests. But the past summer has been accompanied by a partial rehabilitation of sub-tropicals in the eyes of north coast farmers. Reductions in seed prices have favoured more widespread trials of sub-tropicals, and "whole-farm feed-year" studies have pointed to their profitable role.

The "feed-year" approach has caused a majority to think of year-round livestock-feeding. It is prompting the pasture improver to link resources with the farmer, the native-pasture grazier to co-operate with the grain producer, and the winter- and summer-forage crop enthusiast to use the forage to complement the feed produced by native and sown pastures. Storage of hay, silage, and grains is helping to give stability, on a seasonal and a long-term basis.

This broad approach to feeding has been so successful on many farms that the new policy is "feed for production on a year-round basis", rather than merely take what comes cheaply and feed the stock only when necessary for survival in seasonal calamities.

Aerial, Pasture Improvement

Aircraft have increasingly entered agricultural use for "chemical ploughing" (as in the Rockley-Bathurst-Turondale areas), for aerial seeding and top-dressing of non-accessible tableland and slope and some coastal areas, and to apply pesticides and herbicides to crops and sown pastures.

Although there is a trend in the wheat belt to use the larger ground-operating automotive-spreaders, in contract use, at Parkes 491 tons of fertilizer were spread from the air last season—compared with 4,102 tons by various types of ground-spreading machine.

Glen Innes reports that 80 per cent of pasture seed sold in that tablelands area was sown by air. At Mudgee, about 50 per cent of the top-dressing is now done by aerial means.

Native Pastures Assessed More Highly

The drought of 1965–66 and the "stop-go" growth-patterns in pastures in 1966–67 caused a re-assessment of the role and value of native pastures. More than 90 per cent of New South Wales acreage is still in native pastures, and these still provide the greater proportion of the feed for New South Wales livestock. The native grasses have proved excellent energy sources in drought and dry times.

The trend now is to accord them greater value, to advocate their conservation and supplementation with pasture legumes rather than their destruction and replacement by conventional introduced "sown-pasture" species.

Perennial Grasses Enter the Wheat Belt "Pasture Phase"

Annual pasture-species such as Wimmera rye, subterranean clover and Barrel medic have long been the main components in southern wheat-belt pasture-phases, and well-suited to the purpose. But with rising soil fertility there has been an influx of barley grass, capeweed, hair grass and weedy-species; "soaking-up" the clover-boosted soil-fertility.

With availability of a useful range of cultivars of *Phalaris* Cocksfoot, Perennial ryegrasses and Demeter fescue, all showing some adaptability to the more-favoured and even the marginal-farming portion of the wheat belt, the wheat belt now appears to be entering an era of "perennial grass-clover balanced-pasture phase".

Increase of Irrigated Pastures Inland

There has been significant increase this year in irrigated pastures, especially along the inland river systems including the Lower Murray-Darling.

In the Dareton district this year some 2,000 acres have been prepared for irrigation and 4,500 acres of irrigated pastures have been sown. Meanwhile, irrigated summer-pastures in the Barham and Deniliquin districts this year have given phenomenal growth and carrying-capacity.

In the Lower Murray-Darling areas one irrigated-lucerne grower ran 20 sheep to the acre over the spring and summer months, and averaged 12 sheep per acre over the 12 months.

Potassium in Relation to Eastern Districts

Increased attention is being given to the element potassium, in soils-investigations in the eastern part of the State. "Available" potassium in the coastal and tablelands soils is being surveyed, using the Crookwell-Shoalhaven-Moruya-Sydney block as a pilot-area. Recent development of an improved analytic-method is facilitating this research.

The Plague Locusts Threat

Extensive outbreak of plague locusts occurred in the spring and summer, mainly in central and southwestern parts of the State.

A helicopter was used, for the first time here, and with outstanding success, to survey locust-infestations and direct spray-aircraft by radio.

Further progress was achieved with the ultra-low volume aerial-spraying technique; undiluted technical malathion giving excellent control of flying-swarms and nymphal-locusts, and technical fenitrothion showing considerable promise.

CONCERNING VEGETABLES AND FRUIT

Potatoes—Production of Elite Seed

The Department's supply of elite seed to producers of Certified potato seed, this year for the first time, marks the progress of a major project.

Some five years ago, 200 single-plant selections of the important commercial-varieties were obtained from leading growers. These have since been selected for trueness-to-type and freedom from virus and other diseases, whilst appropriate steps have been taken to control virus-vectors. In the past season, tuber-indexing indicated that harmful virus-disease had been virtually eliminated from the selected lines.

By getting new supplies of disease-free stock (elite seed) annually, growers of Certified seed will improve the standard of their product. At the same time their arduous task of hand-removal of off-type and disease-infected plants will be greatly reduced.

Tomatoes Resistant to Verticillium-wilt Introduced

The introduction and testing of tomato varieties resistant to *Verticillium-wilt* has provided local growers with types not affected by this disease. The introductions were from Canada and resistant to the strains of *Verticillium* prevalent here.

As *Verticillium-wilt* has been reported from a number of localities, and appearing more virulent, the release of the resistant varieties has come at a propitious time.

Colour-plate Plant Disease Leaflets

A series of 48 coloured-drawings of plant diseases have been produced, and already 16 of these have been published in the Plant Diseases Leaflet series. They have been highly commended in many places.

Sterilization of Bananas for Fruit Fly

Techniques developed at the Gosford Citrus Wastage Research Laboratory secured infestation of bananas with Queensland fruit fly and several fumigation dosage rates with ethylene dibromide have been tested. Survival occurred at levels up to 10 oz/1,000 cu ft, but levels of 14 to 18 oz/1,000 cu ft appear to offer the required sterilization.

Schools on Post-harvest Handling of Citrus

Two Extension Schools designed to present the most recent developments in fungicidal treatments and post-harvest handling of citrus were conducted at the Citrus Wastage Research Laboratory this year. The first was restricted to officers of the South Australian, Victorian, Queensland, and N.S.W. Departments of Agriculture. The second was designed for packing-house operators and was attended by 60 delegates from all States other than Tasmania and Western Australia.

Use of ethylene dibromide to sterilize fruits likely to be infested with Queensland fruit fly was also discussed in detail. This commodity-treatment success has created considerable interest because of its importance in permitting exports that otherwise could not be made.

Research Affecting Successful Cool-Storage

Cool-storage facilities have increased enormously in the past decade. The present space available in New South Wales amounts to 2,500,000 cases. Of this total 2,134,000 case-space is located in the pome fruit late-districts (Orange, New England and Batlow) and equivalent to roughly three-quarters of the total production in these areas.

Use of diphenylamine (DPA) for superficial-scald control in apples and pears has been approved by health authorities this year, and in the storage-districts much publicity has been given by the Department of Agriculture to the methods of treatment. A large proportion of the Granny Smith crop has been treated with DPA this season, by dipping or wrapping and these methods will quickly supersede the old, oiled wrap method of scald-prevention.

Use of "Controlled Atmosphere" (CA) storage received a substantial boost this year, after a demonstration at Batlow of the value of "tectrol" units designed for quick adjustment to the desired storage-atmospheres. Following the very favourable outcome of the demonstration-fruit, the Batlow Packing house Co-operative has installed units for two new cool-rooms with capacity for 30,000 cases, and a unit has been installed also at Orange.

Provided certain primary cool-storage rules are adhered to, the use of more C.A. storage will help to eliminate the rather unfavourable public impression engendered in recent years by poor-quality air-stored fruit held until late in the year.

At present, most stores in the production areas are filled almost to capacity. The increase in stocks held, compared to this time a year ago, is well over 400,000 cases.

Gibberellic Acid Sprays Increase Yield of Dried Sultanas

In trials at the Horticultural Research Station, Dareton, the dried-weight yield of sultanas was increased by up to 20 per cent, by applying at appropriate strength the growth-promoting hormone gibberellic acid (G.A.) at the shatter-stage of inflorescence-development. An appropriate-strength combination of gibberellic acid and P.C.P.A. (another growth regulator) applied seven days after shatter gave a greater yield-increase than did the G.A. alone.

Increased berry-size was a feature of the higher yields, and accordingly the drying-time was extended by a few days. The treatments also delayed the maturity slightly.

Grapefruit Stem-pit Control

A limiting factor to grapefruit-production in Australia has been the "stem-pit" virus. This adversely affects fruit-shape, size and production; reduces tree-vigour, and causes a pitting of the trunk and limbs.

Experiments have determined the existence of strains of the virus, the strains ranging from mild to severe in symptom-expression.

The work indicated that commercial-protection against severe strains could possibly result from propagations wherein budwood carrying mild strains of the virus were used.

Field trials were located at the Horticultural Research Stations at Narara and Dareton, to test various aspects of protection and cross-infection under normal field conditions in the totally different climatic conditions of coastal and semi-arid regions. The plantings include virus-free trees, trees with and without various mild-strain inoculants, severe-strain trees, and mild-strain trees.

Results so far indicate that symptom-expression by the various strains is much more apparent at the Narara than at the Dareton Station. At the latter, vigour may be temporarily overcoming virus effects. All trials are giving promise that the mild strains exert a protecting effect for several years under normal orchard conditions. Field observations of commercial blocks of trees of known origin also support this.

Some Senior Administrative Staff Changes

THE LATE ALAN PEARSON, DEPUTY DIRECTOR-GENERAL

With deep regret this Annual Report for 1966-67 records the death of Mr Alan Pearson, H.D.A., on 23rd December, 1966. Alan Pearson died suddenly, whilst in the Department on that day.

Only five months earlier, on 7th July, 1966, he had been appointed to the second Deputy Director-General position, responsible to the Director-General for administration of professional and technical matters.

His position prior to this appointment was Chief of the Research Stations Branch. His work in that area since 1954 had been responsible for development of several new Stations and reconstruction of the others.

He had joined the Department as an agronomist in 1929, was District agronomist at West Wyalong and Dubbo from 1936 to 1941, and accepted the Weeds Specialist position at head office of the Division of Plant Industry in 1941.

In 1948 he was appointed as the first Land Settlement Services Officer. In 1951 he became Deputy Chief of the Division of Plant Industry.

Amongst his many achievements whilst Chief of Research Stations Branch from 1954 onwards was establishment and development of the Department's Agricultural Machinery Advisory Service.

The Department, the State, and the Nation are the poorer for the loss of Alan Pearson; an outstanding public servant.



The Late Alan (Ted) Pearson H.D.A.

Alan Pearson died on 23rd December, 1966. His appointment as Deputy Director-General (Professional and Technical Services) was announced on 7th July, 1966.

APPOINTMENT OF Mr B. OWEN FRENCH AS DEPUTY DIRECTOR-GENERAL

Mr Bruce Owen French, Chief of the Division of Horticulture from 1964, was appointed in February, 1967, to the position of Deputy Director-General (Professional and Technical) vice Mr Alan Pearson (deceased).

Mr French graduated from Hawkesbury Agricultural College in 1937, joined the Department of Agriculture in 1938 as a trainee in the School of Agriculture at the University of Sydney, and graduated in 1943.

His subsequent positions in the Department included that of Fruit Research Officer; Manager of Yanco Experiment Farm; from 1957 to 1964, Principal Fruit Officer (Research) in the Division of Horticulture, and from 1964 to 1967 Chief of that Division.

Currently he is also President of the Australian Institute of Agricultural Science.

RETIREMENT OF SOME SENIOR OFFICERS

Chief of Division of Science Services, Dr C. J. Magee

Dr C. J. Magee, Chief of the Division of Science Services since 1958, retired on 16th November, 1966. He had joined the Department in 1920 and his 46 years of service brought many distinctions to this Department and to him personally. Positions held by him at various periods included: Assistant Biologist, Ben Fuller Travelling Scholar, Plant Pathologist, Senior Biologist, and Chief Biologist (1941-1958). His distinguished work on the virus of Banana Bunchy Top disease gained for him the Doctorate degree in the Agricultural Science (University of Sydney).

Chief Entomologist, Mr P. C. Hely

Mr P. C. Hely, Chief Entomologist, Division of Science Services, retired on 17th May, 1967, after 42 years service. He joined the Department in 1925 as a trainee in the School of Agriculture, University of Sydney, and on graduation

accepted appointment as Entomologist. His subsequent career was entirely within the Entomological service, including District and Senior Entomologist positions wherein he rendered distinguished services to the farming community and this Department.

SOME SENIOR APPOINTMENTS, FLOWING FROM THE FOREGOING CHANGES

Mr N. K. Golding, formerly Deputy Chief of the Division of Animal Industry, was appointed as Chief of the Research Stations Branch following promotion of Mr Alan Pearson from this position to that of Deputy Director-General in July, 1966.

Mr T. H. Johns, formerly Chief Chemist, was appointed as Chief of the Division of Science Services following the retirement of Dr C. J. Magee.

Former Senior Chemist Mr A. N. Old succeeded Mr Johns as Chief Chemist.

Dr D. K. O' Neill became Senior Chemist in succession to Mr Old.

Mr G. Pasfield, former Senior Entomologist was appointed Chief Entomologist following the retirement of Mr P. C. Hely.

Dr G. Shanahan succeeded Mr Pasfield as Senior Entomologist.

Mr R. G. Kebby, former Deputy Chief of the Division of Horticulture, was appointed Chief of the Division following the appointment of Mr B. Owen French as Deputy Director-General.

Mr G. R. Gregory, former Principal Fruit Officer (Viticulture) was appointed Deputy Chief, Division of Horticulture following Mr Kebby's promotion.

FOR OTHER "STAFF SECTION" DETAILS

Appendix IV to this Report includes further staff information, including other promotions; officers overseas in the past year; and staff totals, in various categories.

Personnel Work

Induction. Two hundred and twenty-three officers and employees were inducted by Personnel Section. The induction work included a two-days induction course for 45 new trainees appointed early in 1967 for studies at the Universities of Sydney, New South Wales, and New England, or at the Hawkesbury or Wagga Agricultural Colleges. Trainee appointments this year included five trainee laboratory assistants, studying at Sydney Technical College.

Trainees, Numbers. There are now 220 Department of Agriculture trainees at the various Universities and Agricultural and Technical Colleges. Twenty-three trainees are repeating an academic year at personal expense.

Counsellor Scheme for Trainees. A scheme enabling the Department to have an improved contact with each of its trainees has been started. Each of a considerable number of experienced professional officers of the Department has accepted the role of "trainee counsellor", responsible for personal contacts with a few of the trainees.

Staff Counselling. Advice and guidance were provided for a number of officers. Some of the cases were referred to specialists at the Public Service Board.

First Aid Service. This continued until the transfer from Farrer Place to the State Office Block. Since then there has been no need for Personnel Section to continue the service. Other arrangements have been made for the service in those parts of the Department which remain at the Farrer Place address. Provision of first aid equipment for country institutions was supervised.

Career Enquiries. Appropriate publications and information were provided for parents, students, career advisers and other interested enquirers about careers within the Department. There was a steady increase of inquiries from overseas people.

Legal Branch

Acts Passed. These comprised the Pastures Protection (Amendment) Act, 1966; the Fertilizers (Amendment) Act, 1967; the Grain Elevators (Amendment) Act, 1967; the Stock Diseases (Amendment) Act, 1967; and the Tobacco Leaf Stabilization Act, 1967.

Gazettals. Eighteen Regulations, 66 Proclamations, and 59 Notifications were gazetted.

Prosecutions. One hundred prosecutions were taken for offences under the various Acts administered by the Department.

Arbitrations re Agricultural Holdings. Three matters were referred to Arbitration under the Agricultural Holdings Act, 1941.

Registrations. The Registrations effected comprised 287 farm produce agents and 619 veterinary surgeons; compared with respectively 296 and 619 in the previous year.

Veterinary Surgeons Board

The Board met on 12 occasions, as in the previous year.

The prescribed examination for veterinary graduates of overseas universities was held in September, 1966. Of the seven candidates, two passed. As the time prescribed for holding these examinations expired on 1st April, 1967, the Minister approved of a final examination being held in March, 1967. On this occasion four of six candidates passed.

Biometrical Branch

General. The Branch provided consultations and advice for the Department's research workers on design, analysis, and interpretation of experiments and on sampling and survey methods and related problems. Visits to Research Stations for consultations were more frequent this year, a result of recent staff increase.

At the start of an investigation the biometrician helps to clarify and define objectives, to select the precise questions to which answers are to be sought, and to decide the exact plans and procedure to be followed. On completion of the experimental work the biometrician is again available, for mathematical-statistical analyses of the data and to advise on interpretation.

The volumes of consulting work on the design of experiments and of computing work in the analysis of results each continued to increase steeply. This is in line with increases in research establishment throughout the Department.

Further progress was made with the writing of computer programmes. These, especially two omnibus programmes for randomized block and multiple regression analyses, permitted speedier turn-around and the handling of increased work.

Punch-Card Section. Following the Department's ADP Section's completion in June, 1966, of the writing of computer programmes for processing records from Dairy Herd Recording, the Punch-Card Section is now solely concerned with the punching of data into cards for input to computers. However, whereas it originally processed only Dairy Herd Recording records, the Section now also punches and verifies substantial volumes (about 30 per cent of its workload) of computer programmes (biometrical, economics, and data processing) and of research data for biometric analysis.

RESEARCH STATIONS BRANCH

Scope

This is a service branch, not responsible for the research subject-matters but for the following:

Control, administration, and development of the 19 Agricultural Research Stations;

Farm-operations supervision at Hawkesbury Agricultural College, Wagga Agricultural College, and Glenfield Veterinary Research Station;

Supervision of purchase and maintenance of plant, machinery, and vehicles at the Agricultural Research Stations, Hawkesbury and Wagga Agricultural Colleges, Glenfield Veterinary Research Station, Wagga Agricultural Research Institute, the Plant Industry research centre at Berry, the Royal Botanic Gardens, and elsewhere as may be requested by other sections;

Co-ordination and control of the Department's capital works programme;

Supervision of the Architects Branch, through which the Capital Works programme is implemented;

Maintenance of the Western Division Public Watering Places and control of associated staff;

Development and conduct of the Agricultural Machinery Advisory Service and an applied research programme.



At Leeton Agricultural Research Station: Stacking the baled pasture-hay

The Department's Research Stations were able this year to restore their grain and hay reserves to pre-drought levels. Their fodder-stocks by May, 1967, included 76,900 bushels of grain (worth about \$87,640) and 1,895 tons of hay (worth about \$37,900)

The Research Stations

DEVELOPMENTAL FEATURES

Acquisition of Land

About 45 acres was transferred from the Narrabri Pastures Protection Board to accommodate expanding research programmes at the Narrabri Agricultural Research Station.

Purchase of another 100 acres to expand Wollongbar Agricultural Research Station is being negotiated.

Acquisition of Grafton Common and part of an adjacent travelling stock reserve is in hand, to expand beef cattle/pasture research at Grafton Agricultural Research Station.

Transfer of further areas from the Department of Public Health to increase the research area of Orange Agricultural Research Station has been formally requested.

Additional Buildings

Additional buildings and facilities at a number of Stations was a major developmental feature this year. The buildings included structures for residence, research, storage, and education. There is later reference to these under "Capital Works Programme".

Examples are: the glasshouses at Griffith and Tamworth, shed for cotton-research at Narrabri, cotton-pollination cage at Narrabri, poultry-laying cage-house at Seven Hills, pig-metabolism shed at Wollongbar, granaries at Trangie, Tamworth and Glen Innes, and cottages at Condobolin and Trangie.

Other Improvements

Irrigation Facilities. These were extended at Alstonville, Dareton and Bathurst. Eleven Stations now have irrigation systems. Use of irrigation in research increased this year.

Paddock Subdivision, and Clearing. This was increased at Grafton. Expanding pasture and livestock research-programmes at Trangie, Condobolin and Temora required considerable subdivision.

Appreciable clearing was completed at Trangie and Condobolin and at Orange, because of the expanding research-programme.

At Yanco Agricultural College and Research Station the re-planning of the irrigated area neared completion. Re-planning of the "dry" area is to proceed, to meet expanding needs. Several ground-tanks have been sunk as a preliminary.

Building Maintenance

Building maintenance proceeded at all Research Stations, and \$67,000 from Consolidated Revenue was expended on it. The work included some minor new structures such as grain silos, fruit-drying racks, sheds, farrowing pens, a poultry-laying cage-house, and a garage, but the expenditure was generally incurred on repairs, extensions, renovations, alterations, and work-facilities of existing buildings. Some \$15,000 was spent on minor additions and water supply.

Fencing, Roads and Road Repairs

Fencing expenditure from Consolidated Revenue was \$14,500. Major individual works were fencing of the additional area at Narrabri and fencing for major research-projects at Condobolin, Griffith, Leeton, Tamworth, Temora, Trangie and Wollongbar.

The continuing-programme of tar-sealing public entrance-roads and some surrounds of administrative buildings has almost been completed. Grading, surfacing and maintenance of surface condition of internal roads received constant attention. About \$2,800 was expended on the roads.

Aesthetics

Tree and shrub plantings proceeded at several Stations. Leeton Agricultural Research Station gained 1st place in Zone 5 of the *Sydney Morning Herald* Garden Competition in 1966 and 2nd place in 1967. In 1966 the Station's garden was placed 3rd in the State-wide competition.

OPERATIONAL

Fodder Production and Utilization

Conditions were more favourable to grain and hay production than in the previous year. Research stations were able to restore reserves to the pre-drought levels, meet their own current needs and, as well, those of coastal research stations where there is livestock research but inability to produce large quantities of winter-cereal grains.

Fodder stocks in reserve at 21st May, 1967, comprised 76,900 bushels of grain, valued at about \$87,640, and 1,895 tons of hay valued at about \$37,900. Fodder transferred from producing to consuming Stations for conduct of live-stock research comprised 26,365 bushels of grain, valued at about \$59,920, and 149 tons of hay valued at about \$5,015.

Pure-seed Production

Pure-seed production continued at appropriate Stations. These Stations produced sufficient winter-cereal seed to meet the needs of experiments, pure-seed increase, approved-seed growers, their own crop-production, and for general crop-production on Stations not in seed-production work.

Glen Innes and Grafton Stations produced basic material for the Department's maize seed-production scheme. Narrabri and Yanco Stations produced cotton seed for the seed-improvement project; and Orange Station grew the potato seed for the seed-production scheme.

Condobolin Station produced 7,500 lb of certified Barrel Medic 173 seed, practically the sole harvest of this species in Australia in 1966-67.

Livestock at the Stations

Re-distributions, following the temporary transfers made to meet the drought contingencies in 1965-66, together with natural increases and some minor purchases restored stock numbers to normal at most Stations.

Machinery, Apparatus and Equipment

About \$75,000 was expended from Consolidated Revenue funds on machinery, apparatus and equipment. Considerable plant for research purposes was purchased also with Industry Funds and from Commonwealth Grants monies.

Motor Vehicles

The suitability of "Mini Mokes" for use on Research Stations was tested and application has been made for four, to be used "on Station".

Stores, Minor Plant, Plant Repairs, etc.

Stores, minor plant and equipment, repairs to plant and equipment and other material and services were supplied or provided to the total value of \$175,000.

Revenue Production

While research work remained the basic purpose of Research Stations the revenue from fruit, livestock, cotton, cereal seed and other products from the projects amounted to \$314,800 (this includes also the revenue from Agricultural Colleges and other Institutions).

Other Departmental Institutions

DEVELOPMENTAL

Acquisition of Land

Purchase of about 138 acres for addition to the Agricultural Research Institute, Wagga, is being negotiated.

Additional Buildings, and Other Improvements

The main activities comprised buildings and laboratories for research or education, and accommodation for students and personnel. Some works were completed; others are in the course of erection. The expenditure is included under "Capital Works Programme".

Some of the items were at Hawkesbury Agricultural College: a gymnasium, a school of Dairy Technology, and renovation of the Science Block; some at Wagga Agricultural College: extension to a student accommodation building and erection of an Engineering/Machinery Demonstration Unit; and three research-buildings at the Agricultural Research Institute, Wagga.

An irrigation unit purchased in 1965-66 for use at Glenfield Veterinary Research Station for Station fodder-production was installed. Also, a proposed weir to provide a secure supply of water is being negotiated.

OPERATIONAL ACTIVITIES

Building Maintenance and Alterations

Building-maintenance and alterations were supervised at Hawkesbury and Wagga Agricultural Colleges, to an approximate expenditure of \$26,000, and at Glenfield Veterinary Research Station.

Machinery, Apparatus, Equipment, and Vehicles

The Colleges, Glenfield Veterinary Research Station and Wagga Agricultural Research Institute were assisted in purchasing considerable machinery, apparatus, and equipment for their operational and research programmes. They were included also in machinery- and vehicle-maintenance supervision by the Plant Inspectors.

Capital Works Programme

The Department's Capital Works Programme included considerable activity in provision of facilities for other sections of the Department besides the Research Stations, the Colleges, the Veterinary Research Station, and Agricultural Research Institute. Supervision and co-ordination of the programme were done through the Architect. The total cost of works completed, under construction, and planned, including those already mentioned under the headings "Research Stations" and "Other Departmental Institutions" is estimated to be: work under the Department's Architect's immediate supervision—\$478,240; work done by the Public Works Department and the Housing Commission (but the Department's Architect involved)—\$863,600; total—\$1,341,840.

Main sources of finance for these Capital Works were the General Loan Fund, the Commonwealth State Grant (Science Laboratories and Technical Training) Act, and Industry Funds.

Major works included in the programme at centres other than Research Stations and Agricultural Colleges were: a glasshouse at the Royal Botanic Gardens, the Pesticides and Bio-assay Laboratory at Rydalmere, a workshop and implement shed at Centennial Park, and the District Veterinary Laboratory at Armidale.

Plans and specifications were prepared for an administration building at Ashford, and offices for the Pastures Protection Boards at Coonabarabran and Bourke.

General Extension Work by the Architect

In response to inquiries from farm people the Department's Architect issued drawings for miscellaneous buildings to an estimated value of \$106,000: shearing sheds and yards, hay-sheds, horse stables, cattle yards, sheep yards, residential quarters, dips and feed troughs and other items.

Drawings were also sent to public authorities in other States, giving details of laboratories and other research installations at Stations.

Western Division Public Watering Places

There are some 300 Public Watering Places in the Western Division for travelling stock. Reconditioning of the water storage tanks, bores, and equipment continued. Funds for the purpose came from Consolidated Revenue, \$90,000, and the Drought Relief Grant, \$45,000; total \$135,000.

Work was done in all Pastures Protection Districts in Western Division. Ninety-six sites received attention.

With 1965-66 expenditure of \$152,000 on similar work, the total expenditure of \$290,000 in the two years 1965-67 has these public utilities in reasonable condition.



Ground-tank supplying water for stock in Western Division

The Department is responsible for 300 Public Watering Places in the Western Division. This year \$135,000 was spent there, on 96 of the sites; reconditioning water-storage tanks, bores and equipment, as part of the continuing programme

Farm Mechanization Section

STAFF INCREASE

An additional Agricultural Machinery Officer has been appointed, to the North Coast Agricultural Region. Also, an Agricultural Engineer has been appointed to Head Office for applied research.

EXTENSION SERVICES

A large range of media were used by the Farm Mechanization Section. The activities are outlined, as follows:

Field Days. The Agricultural Engineer and Agricultural Machinery Officers serviced 48 field days where agricultural machinery was shown, demonstrated and discussed. The Machinery officers were active participants in executing all the major machinery field days in the respective Region and staged special exhibits at three.

The officer at Orange acted as Publicity Officer and as the Department's permanent member of the Committee for the Australian National Machinery Field Days. He and the Agricultural Engineer were in the judging panel for the "New Implement and Practical Aids Award" at this field day. Similar assistance was given the respective Regional officer at the Riverina Machinery Field Day and at the Berrigan Summer Crop and General Field Day. Attendances at these three Field Days aggregated 48,500.

Specialist Field Days on citrus-spraying machinery were organized.

Short-term Schools. Eleven short-term schools on tractor maintenance and welding were organized and conducted by the Agricultural Engineer and Agricultural Machinery Officers. The aggregate attendance was 293.

Conferences and Meetings. The Agricultural Engineer prepared material for and attended 26 meetings and conferences. He personally delivered 13 addresses at these gatherings.

Agricultural Machinery Officers addressed 46 meetings and schools organized either by the Agricultural Bureau or other farm organizations.

Radio and Television. Radio in particular, and television, were extensively used by the Machinery officers; 187 tapes were recorded for use on rural radio stations and six scripts were prepared for "live" presentation on television.

Press and other Publications. One hundred and twenty-one items were prepared for publication in the rural press and three special articles were published in the M.I.A. *Farmers*

Newsletter, including a report of investigations into rice headers, prune dehydration and bulk-handling of fruit. An article was published also in the *Central Coast Farmers Newsletter*, and another in the I.R.E.C. (Griffith) publication *A Guide to Cotton Growing*.

Ten articles were published in the *Agricultural Gazette of N.S.W.* (see Appendix II).

Service to Individuals. The preceding paragraphs refer to mass and group methods of extension. A large volume of individual-contact extension was achieved with landholders; by telephone, letter, and personal visits to properties, and through office-visits. These contacts are increasing in the Regions where agricultural machinery officers are well established.

Notably, the Southern Riverina has requested that an additional officer be located in the South Western Agricultural Region. Significantly this indicates acceptance of the service by the rural community.

Liaison with Manufacturers, Dealers, etc. Close contact was maintained with machinery manufacturers, dealers, and agents in the metropolitan area and in all Regions where the service operates. This was important in extension and investigational work. Inquiries from dealers concerning suitability of new equipment increased, and the officers made 328 calls on dealers.

Improvement in machinery service was apparent, and in availability of spare parts in certain areas, as a result of this liaison.

OTHER ACTIVITIES

Safety in Rural Industry

The Agricultural Engineer served in an Executive/Advisory Committee for Safety in Rural Industry, set up by the Minister for Labour and Industry, and in the Inter-Departmental Committee on Occupational Health and Safety appointed to advise the Public Service Board. Also, he represented the Standing Committee on Agriculture in the planning committee for the first National Seminar on Safety in Rural Industries. He addressed the Seminar on the part State Departments of Agriculture can play in promoting safety in agriculture.

The Engineer co-operated with the Commonwealth Department of Labour and National Service to prepare a booklet on "Agricultural Machinery Safety" and 20,000 of the booklet were allocated for N.S.W. distribution through the Extension Services.

Seven posters prepared by Department of Labour and Industry were reprinted in the *Agricultural Gazette of N.S.W.* and two other articles on rural safety were published.

Film Productions

"Electricity in Agriculture". The Commonwealth Department of Primary Industry was assisted to produce a film *"Electricity in Agriculture"*, released for extension use throughout the nation.

"Grain Dryers". The Engineer helped the compilation of script for this film now in production.

Standardization of Agricultural Machinery

The Agricultural Engineer assisted the Standards Association of Australia to draw up standards which affect agricultural machinery in this State. He also was a member of the Committee which this year published the new Australian Standard for Rating Small Internal Combustion Engines.

Assistant in Education

Papers on "Agricultural Engineering" were set and marked for the Public Service Board Regulation 124 Examination. The Engineer acted also as assessor in Agricultural Engineering examinations at the Department's Agricultural Colleges.

He assisted the Syllabus and Examination Committee of the Department of Education in the Higher School Certificate subject "Farm Mechanics", and compiled notes on the Farm Machinery Section of the Syllabus for teacher-guidance.

Agricultural Engineer's Overseas Visit

The Agricultural Engineer is now overseas for the World Symposium in Agricultural Engineering, London, and the North American National Conference in Engineering at Saskatoon, Canada.

He will study trends in agricultural engineering research, extension and education, in the course of this visit, and will examine the latest machinery and methods for fodder conservation in the U.S.A., Canada and United Kingdom.

RESEARCH IN AGRICULTURAL MACHINERY

The Agricultural Engineer appointed for research has taken preliminary steps in several projects: investigations into spraying machines used in the central coast citrus industry, to improve efficiency in disease and pest control; reasons for inefficient rice-harvesting; the value of permanent electric-fencing and the operational methods; wheat bulk-handling systems; engineering aspects of farm-storage of wheat; and merits of various machines for pasture-establishment in the North Coast and the Southern Tablelands Regions.

Development of a rotary sod-seeder to establish tropical legumes in terrain and under conditions where conventional seeders cannot operate was supervised by the Agricultural Engineer.

Agricultural Machinery Officers at the request of farm organizations continued to investigate the application of Californian methods of harvesting, bulk-handling and dehydration in the prune industry; bulk-handling of peaches and pears in the Murrumbidgee Irrigation Area; orchard-spraying equipment for control of two-spotted spider-mite, and also equipment in general use in citrus production.

A project assessing the suitability of farm machinery used in the Carabost district was completed. The report has been presented to district farmers.

This year farm organizations requested the Department to investigate twelve more agricultural-engineering problems. This helps to underline the growing recognition of the Agricultural Machinery Advisory Service.

DIVISION OF PLANT INDUSTRY

General

STAFF

Increased Numbers

The Division began 1966-67 with 145 established positions but 14 of these vacant. It ended the year with 159 established positions but 14 of these vacant. Nine of the fourteen vacant are research positions. The net gain of fourteen in number of positions occupied resulted from recruitment of twenty-six new officers, loss of nine by resignations (seven college diplomates and two university graduates), one intra-departmental secondment and two retirements. Of the twenty-six newly

appointed officers (fifteen graduates and eleven diplomates), thirteen are in research and thirteen are being developed for extension positions.

Two of the fourteen positions added to the establishment-strength this year are of particular interest. They are agronomists for cloud-seeding, rainmaking operations. Of the twelve others added, three are District agronomist (extension) and nine are research positions. Six of the new positions are financed from Commonwealth Extension Services Grant funds (three for extension and three for research), five from Consolidated Revenue funds, one from Meat Research Committee Funds and two from Australian Wool Board funds.

Post-Graduate Study and Training

Ph.D. Studies. Two research agronomists returned with Ph.D. degrees from study-leave in the U.S.A. Two others commenced post-graduate studies aimed at Ph.D. degrees, one in the U.S.A. and one at the University of New England. One other continued post-graduate Ph.D. studies in the U.S.A. and another continued studies towards the Ph.D. at the University of N.S.W.

Extra-departmental Secondment, and Training. Five research agronomists continued on extra-departmental secondment; one at the University of New England for agronomic research towards control of bloat, and four at the CSIRO Division of Plant Industry, Canberra, in the co-operative "research cum training" programme. Two more plant breeders attended the one-year advanced training course the CSIRO Division of Plant Industry, Canberra, has been conducting in recent years.

Regional Conferences

One Regional Research and Extension Conference was held. This was at Goulburn.

Plant Exchange

Six hundred and thirty-eight introductions were made and 588 seed samples were sent to overseas research workers.

EXTENSION ACTIVITIES

New Districts

Continuing the policy of subdivision of agronomist districts to meet the increased demands brought about by increased agricultural production, three new districts (Cooma, Hay and Condobolin) have been created since July, 1966. In addition to these new districts, action has been taken to create more in 1967-68—with headquarters at Gosford, Kempsey and Coleambally.

Training Agronomists for District Positions

The overall scheme for the training of field officers for district extension duties was reviewed. This training scheme, first adopted by Division of Plant Industry in 1962, is proving successful in providing officers to fill district positions.

Despite six resignations, creation of the three new districts previously mentioned, and the transfer of four officers from the Extension Section to other positions in the Department, it is anticipated that all district vacancies will be filled by July, 1968. The programme provides for two positions to be filled in August, 1967, two in September, 1967, two in December, 1967, and three by July, 1968.

Activities of District Agronomists

The district agronomists' work-average was 225 days: 78 days on office work; 18 at conferences and meetings; and 129 days on field work including field days, crop and pasture investigations, land-settlement matters, seed certification and registered seed areas, farm competitions and agricultural shows, and flood, bushfire and drought investigations.

The proportion of time spent on respective activities has not changed much from the previous year, except that time spent at conferences and meetings increased per officer from twelve to eighteen days.

District agronomists serviced 208 field days (attendance 11,829), 177 meetings (attendance 6,228), 856 radio broadcasts (and television), and 540 Press releases.

Services to Land Settlement

The Principal Agronomist (Extension) continued to be this Department's representative for contact with the Closer Settlement Advisory Board of the Department of Lands, and to co-ordinate work by other officers concerned in land settlement inspections.

The amount of closer settlement work declined. Only two new estates, comprising about 15,000 acres, were inspected. The Principal Agronomist (Extension), the respective District agronomist and members of the Closer Settlement Board did the inspections. Five other estates were visited by District agronomists and/or the Principal Agronomist (Extension).

Settlers on "The Cuan" and "Grampian Hills", in Muswellbrook district, and on "Fairview" and "Bongongo", in Tumut district, who have been unsuccessful for various reasons, are receiving special attention from the respective District agronomist.

The work by District agronomists in connection with selection of estates and subsequent design into farms, and later their advice to new settlers, are important in implementing the land settlement scheme.

Services to Irrigation

A natural effect of the drought was increased State-wide interest in irrigation. There was widespread activity in sinking of bores and wells, dam construction, and installation of various types of irrigation. But the position in regard to water supplies from storage dams on rivers remained precarious and very strict controls were continued by the Water Conservation and Irrigation Commission on pumping for all purposes.

In May and June, 1967, rain replenished many of the major dams but not to their capacity.

Underground sources of water enabled good production of cotton in the Namoi Valley and of grain sorghum and maize in the Quirindi-Caroon-Breeza areas. Discovery of vast underground-water resources in the lower Lachlan Valley is

giving rise to new industries there, including the probability of a large tract of hitherto-grazing land being diverted soon to the production of cotton and perhaps maize and grain sorghum.

District agronomists increasingly have been called upon by landholders for advice on irrigation practice and management, for a wide range of crops and situations. The in-service irrigation-training schools have been specially justified. This year, in January, a further school was conducted, in general for younger officers. It was attended by 54 agronomists and fruit officers and brought to more than 300 the total of officers so trained.

The policy of appointment of an agronomist to each Region to specialize in research-extension concerned with irrigation has been implemented as far as possible. An officer has been appointed and is undergoing intensive training in irrigation-research techniques with the CSIRO at Griffith.

In the developing Coleambally Irrigation Area the Water Conservation and Irrigation Commission was further assisted in regard to design of farms. Departmental extension services were also readily available to the settlers there.

In administration of the Farm Water Supplies Act the W.C. & I.C. forwards for report by this Department, any application seeking an advance of \$4,000 or more. This year 148 were received, as against 136 in 1965-66, 86 in 1964-65 and 57 in 1963-64. Numerous requests for advice on agronomic features, to assist design of irrigation plants not the subject of a loan-application, were also received from the W.C. & I.C.



Irrigation facilities for research

Eleven of the Department's Research Stations now have irrigation facilities to aid their research. This year the irrigation facilities were extended at Alstonville Tropical Fruits Research Station, Dareton Horticultural Research Station and Bathurst Agricultural Research Station, and an irrigation unit was installed also at Glenfield Veterinary Research Station

A large volume of inquiries from landholders continued, concerning development of spray and flood irrigation projects, crops and pastures to sow, construction and desilting of dams, prevention of seepage from dams, and evaporation.

In late May cyclonic rains on the north coast led to severe flooding in all coastal rivers from the Tweed to the Macleay, and to a lesser extent in the Hastings and Williams Rivers. Where flood mitigation works have been installed, reports indicated that each has functioned well and that flood waters have drained off much quicker than before the works were installed. Although this Department is not involved in construction of these works the Special Agronomist (Irrigation) is closely concerned consultatively with Department of Public Works and Water Conservation and Irrigation Commission in planning the works.

The Special Agronomist (Irrigation) represented the Department in a number of Committees. These (with the originating body in parentheses) and the number of meetings, are as follows: Hunter Valley Conservation Trust (Department of Conservation), 12 meetings; Water Pollution Committee meetings (Department of Public Health), 5 meetings; Water Research Foundation, State Committee and Research Sub-committee, 4 meetings; Hawkesbury River Flood-Inquiry Committee (Water Conservation and Irrigation Commission), 2 meetings; Closer Settlement of Catchment Areas (Department of Lands), one meeting; Macquarie River and Menindee Irrigation Development-Investigations Committees (Water Conservation and Irrigation Commission), two meetings; and Centennial Park Trust, two meetings.

Service to the North Coast Feed Year Assistance Scheme

To assist north coast dairy farmers who are outside the milk zone to increase future productivity and profitability, the Government introduced the North Coast Feed Year Assistance Scheme on 1st October, 1966. The scheme, to continue for five years, provides financial aid to farmers to develop a farm feed-year programme.

Research by the Department over the past 15 years has been concerned with a major problem of the dairy industry on the north coast, the lack of through-the-year continuity of high quality feed. It has shown that the adoption of a feed-year programme could bring increased production and profit.

A number of feed-year programmes suitable for various districts and different soil types have been evolved.

Already, success of the Scheme is reflected by the fact that production from almost every dairy produce factory was longer-maintained into autumn this year than has been so in the past. The manager of Norco Co-operative Ltd, Lismore, reported a 30 per cent increase in production by his suppliers in the Tweed-Richmond area, compared to production two years ago, and a production-average higher than in any of the previous 45 years. Part of the increase may be attributed to the autumn conditions, but a significant part of the credit must be given to farmers' adoption of feed-year programmes under the North Coast Feed Year Assistance Scheme.

The assistance Scheme has greatly stimulated farmer-acceptance of "feed-year" research results. Many farmers who made little or no previous contact with extension service are now adopting and/or discussing feed-year programmes. At 30th June, 1967, the total of applications for assistance under the Scheme was 3,328; about 60 per cent of the eligible farmers.

A recently-commenced survey has already revealed in the Lismore district alone that 215 farmers (from 484 applications) had indicated *permanent*, tropical and/or temperate pasture species would be part of their overall feed-year plan. Twelve per cent of these farmers were sowing *permanent* pasture species for the first time—stimulated to do so by the Feed Year Assistance Scheme.

The effect of these pastures in increased production will continue long after expiration of the Scheme in 1971, and success of areas established under the Scheme will result in a general adoption of feed-year programmes on the north coast.

Weeds Work

NOXIOUS-PLANT ADMINISTRATION

The Noxious Plants Advisory Committee

The Noxious Plants Advisory Committee, under the Chairmanship of the Special Agronomist (Weeds), developed further as main co-ordinating link between the Department of Local Government and this Department and between Local Government bodies and the Government generally, on noxious-plant matters. Many of the Committee's recommendations and reports again were based on investigations and reports by District agronomists.

The State Government again granted \$400,000 to assist Councils' noxious-plant control programmes. Most of the grant was on a \$ for \$ basis to control the more dangerous noxious-plants on public lands and to employ weeds inspectors. Direct grants were made in a number of cases for control of the more dangerous noxious plants, especially serrated tussock (*Nassella trichotoma*), St John's wort (*Hypericum perforatum*) and groundsel bush (*Baccharis halimifolia*) on vacant Crown lands.

Cost of Council programmes supported by the Committee increased by 15 per cent over the previous year. Much of the increase was because of the sharp increase in activities of a number of Councils previously active only in minor ways.

A number of Shires have appointed weeds inspectors for the first time. However, noxious-plant control in several areas remained unsatisfactory. In this respect the Committee has initiated a special project concerning a group of northern Shires.

A feature of the Noxious Plants Advisory Committee's activities this year was the number of meetings held in country centres—at Albury, Goulburn, Inverell, and Quirindi. Representatives of the Committee visited Bathurst and Lismore and the Chairman represented the Committee at Hay. In each case, personal contact was made with a number of local Councils.

The Chairman also represented the Committee at the Shire Association Annual Conference and the Pastures Protection Board's Annual Conference, each in Sydney.

At Albury a two-day conference was held with representatives of the Weeds Advisory Committee from South Australia and the Vermin and Noxious Weeds Destruction Board of Victoria. Significantly, this was the first such interstate conference dealing with noxious weeds legislation and its administration.

Other Committees

Australian Weeds Committee Formed. This year the Australian Agricultural Council established an Australian Weeds Committee in which the Special Agronomist (Weeds) represents the N.S.W. Department of Agriculture. This Committee has met twice. It is intended to keep note of problems of weeds and their control, with particular reference to matters requiring co-ordination between States.

Committee on Common Names for Pesticides. The Special Agronomist (Weeds) has represented the Australian Weeds Committee in the "Common Names for Pesticides Committee" of the Standards Association of Australia. This one is preparing a schedule of common names for the many pesticides currently in use or under test in Australia.

The Weeds Section is represented also in the "Agricultural Spray Nozzles Committee" of the Standards Association Committee.

CHANGING EMPHASIS IN WEED CONTROL IN CEREALS

In 1967, as in 1966, weed infestations in wheat have been far more severe than normal, reflecting the dry conditions which prevented adequate control during fallow. For control of skeleton weed (*Chondrilla juncea*), and thistles, 2,4-D continued to be the main herbicide used and has been applied to about 20 per cent of the sown acreage.

Growing recognition of annual grasses, especially wild oats (*Avena* spp.), as weeds in cereals has been reflected by a rapid increase in treated area although this is still only 2 per cent of the sown acreage. Farmers have spent almost as much on herbicides for this purpose as they have spent on 2,4-D.

There has also been considerable treatment of fumitory (*Fumaria* spp.), yellow burr weed (*Amsinckia* spp.), and black bindweed (*Polygonum convolvulus*) which are not adequately controlled by 2,4-D. The new herbicides, bromoxynil, linuron, and prometryne, have been used for such weeds.

Native perennial weeds have caused concern in newly developed wheat areas in the northwest. The main ones are *Senecio daltonii* and *Polymeria longifolia*.

SERVICES TO FIELD OFFICERS

"Weed Control Workbook"

The Weeds Section has prepared and distributed a "Weed Control Workbook" for use by extension and research officers of the Department. This workbook is an up-to-date source of information on many aspects of weed control and so designed as to be kept up-to-date with regular supplements. The handbook has led to many favourable comments.

Special "Information Sheets"

To provide a better service to field officers in the identification of plants and advice on their importance or control, a special sheet has been designed and distributed. Besides the type of information to facilitate identification and advice, the sheet gives botanists and Head Office personnel a better picture of plant problems in country districts. Circulars dealing with specific weed problems have also been issued.

WEED RESEARCH

General

Research programmes of the five agronomists full-time on weed research have developed satisfactorily. It has been or soon will be possible to recommend more effective weed control in many situations. The Weeds Section has also been able to co-operate or advise on several weeds research projects being handled by agronomists and fruit officers in situations not covered by the weed research agronomists.

Evidence of the need to develop weeds research in depth continued. Companies concerned with testing herbicides on crops increasingly look to the Department to investigate more basic aspects of herbicide use. Various authorities are concerned with the long-term effects of increased herbicide use on wild life and crops. Also there is increased farmer interest in the economics of weed control by herbicides, in the effects of herbicide use on agronomic practice, and in methods other than chemical weed-control.

Weeds Research, Bathurst Agricultural Research Station

Serrated Tussock (*Nassella trichotoma*). Work continued with areas in Bathurst districts and southern tablelands districts, on aspects of the killing of tussock and replacement-establishment of aerially-sown pasture. Advances were not spectacular this year, due to dry conditions on the southern tablelands, and the work near Bathurst being concerned with confirmation of previous findings.

Native Grass Areas. Preliminary trials were undertaken on use of herbicides to prepare areas wherein to establish improved species in pastures comprising native grasses. The work has indicated several herbicides that might be useful in this regard.

Herbicides in Apple Blocks. Two trials are proceeding to determine herbicide tolerance of young and old apples. Four herbicides, amitrole, simazine, diuron, 2,2-DPA are being tested at several rates. So far, 2,2-DPA at 10 lb per acre has caused unexpected damage on mature trees, possibly due to dry conditions. Companies marketing 2,2-DPA have been requested to amend their labels to warn users of the possible damage in some years.

Weeds Research, Hawkesbury Agricultural College

Research on weed control in vegetable crops continued. In respect to carrots the work has reached the stage of field testing. Excellent weed control has been obtained by using a combination of herbicides; trifluralin used pre-emergence has given the best grass control, with either linuron or prometryne, pre-emergence or post-emergence, for control of broad leaf weeds.

Herbicide screening in transplant and direct seeded tomatoes has revealed that, of the present commercially available chemicals, trifluralin is best for transplant and dephenamid for direct seeded tomatoes.

Preliminary testing was also undertaken in onions, beetroot, lettuce, and parsnips, and indicated that for each crop there will be one or more herbicides for recommendation.

Herbicides to control spiny emex (*Emex australis*) and for weed control in summer legumes, were also on trial. Another trial investigated mechanical incorporation of trifluralin into the soil, and the rotary hoe was the most efficient means.

Weeds Research, Tamworth Agricultural Research Station

The weeds work at this Station has been concerned mainly with wild-oat control in wheat crops. Some work was also done in linseed and summer crops. A programme to study spread and control of skeleton weed has also been started.

Available wild-oat control herbicides have been tested to determine weed and crop response. Some wheat varieties show susceptibility to barban under conditions of late or too high a rate of spraying. Festiguay is the most susceptible. In a field trial none of the recommended wild-oat chemicals damaged wheat when applied according to recommendations.

Further work with barban has indicated the possibility of using lower rates of the chemical.

Weeds Research, Yanco Agricultural College and Research Station

The main projects have been concerned with weed control in cotton and rice.

Weeds in Rice. The new herbicide molinate was extensively tested. A recommendation for its field use has been made on the basis of several years' testing.

Work also started on the problem of *Damasonium minus* in rice. Of the chemicals tested, MCPA was superior whilst 2,4-D, ioxynil, and diquat were less effective on the weed and caused some crop damage.

Weeds in Cotton. Of the herbicides tested, the most efficient were trifluralin, prometryne, fluometuron and norea. Combinations of grass-specific and broad-leaf specific chemicals appeared to be most useful.

Herbicide-incorporation methods are also being examined.

Hormone-Drift in Cotton Areas. The spray-drift from various types of equipment was studied to determine a safe and cheap means of controlling Bathurst burr (*Xanthium spinosum*) in cotton areas. The early indications are that 2,4-D used through standard booms at a high volume of water per acre or through the Vibro Boom will be useful.

Weed Control in Tobacco, at Ashford

Herbicides tested for weed control in tobacco included trifluralin, benefin, dacthal, vernam and tillam; benefin has a greater selectivity than trifluralin in tobacco. Serious plant-damage did not occur until the benefin rate was four times that needed for weed control; whilst with trifluralin the ratio was two times the rate for weed control.

For nut grass control, tillam and vernam were tested; vernam gave good control but killed crop plants; whilst tillam controlled nut grass for a few weeks without killing crop plants.

Weeds Research at Other Stations and in Districts

A trial at the Tropical Fruit Research Station, Alstonville, to evaluate the use of herbicides in bananas has provided valuable information. Supplemented by chipping and contact herbicides, diuron was the outstanding treatment on basis of cost and efficiency.

At Dareton Horticultural Research Station continued investigation has shown that low rates of diuron give weed-control for six months without any citrus damage.

A preliminary trial at Temora Agricultural Research Station has indicated several herbicides useful to remove barley grass from lucerne in non-irrigated lands. These herbicides will be evaluated in further trials.

Several District agronomists have established trials: to test a number of herbicides on boxthorn (*Lycium ferocissimum*); to demonstrate the usefulness of recommended control of *Oxalis pescaprae*; to demonstrate the use of lucerne to suppress skeleton weed (*Chondrilla juncea*); and the use of ploughing and cropping to reduce tussock grasses.

Biological Control of Lantana

In a co-operative project with the CSIRO, Queensland State Departments and the Forestry Commission, two parasites of lantana (*Lantana camara*) have been introduced from Hawaii after extensive testing there, and released. The parasites are the leaf-mining beetles *Octotoma scabripennis* and *Uroplata girardi*.

WEED SECTION'S LIAISON WITH CHEMICAL INDUSTRY

Companies marketing herbicides have drawn on the Department for guidance in respect of their herbicide research. It has been possible to assist the companies by inspection of trials, discussion of results and, in some cases, joint projects. This liaison with industry research-personnel has broadened the effective source of information available to the Weed Section and been most helpful in preparation of extension material.

This year a number of new herbicides were submitted for registration, and a notable feature of the submissions was the increased Australian research-content in the supporting documents. In consequence, it was possible to recommend registration with more confidence. New herbicides registered for use were benefin, diphenamid, bromoxynil, fluometuron, molinate, whilst an increased range of uses was approved for a number of others.

Pastures Work

PASTURE ACREAGES AND TRENDS

Sown Pasture

Acreages of sown pasture in New South Wales at present comprise 9,860,000 acres of grasses and clovers (including 1,024,000 acres of paspalum) and 1,281,000 acres of lucerne; a total of 12,165,000 acres; and as yet unknown but considerable total of recently aerially-seeded and topdressed acreage on the tablelands and slopes. For Australia the figures are 48,519,000 acres of grasses (including paspalum) and clovers, and 2,560,000 acres of lucerne (half in New South Wales); a total of 51,074,000 acres.

Native Pasture

The drought of 1965-66 and the "stop-go" growth-patterns in sown pastures in the past year have emphasized the role and value of native pastures, especially under difficult seasonal or drought conditions. The trend this year has been to accord greater value to native pastures, especially the native grass portion; to advocate their retention and supplementation with pasture legumes, rather than to destroy and replace them by introduced "sown-pasture" species.

Native pastures grasses infiltrated by naturalized or sown pasture legumes produced over 40 lb of wool per acre at Shannon Vale Nutrition Station this year. This continued their good performance in the 1965-66 drought when they carried four wethers per acre without grain-feeding. In the Burren Junction area the seasonal production of native pastures, basically Plains grass (*Panicum aristiglumis*) and Mitchell grasses (*Astrebula* species), are being compared with lucerne's seasonal contribution.

Irrigated Pastures

Interest in irrigated pastures significantly increased this year, especially along the inland river systems, including the Lower Murray-Darling systems.

Most notable trends in southern irrigation areas are: increasing use of gypsum on heavy soils, to promote water penetration; increased use of superphosphate, 4 cwt per acre on summer pasture and 1½ cwt per acre on annual winter pasture; and earlier and more frequent watering. Nitrogen fertilizers are being increasingly used on crop and forage areas; to some extent on pastures.

PASTURE RESEARCH

Pasture research continued at the Agricultural Research Stations, Institutes and Agricultural Colleges, and agronomists based on Berry, Canberra, Maitland and Taree did "adaptive" research.

The Range of Pasture Investigations

The lines of research included: native pastures; sown-pasture species and mixtures; pasture establishment; pasture biology (embracing *Rhizobium* relationships and disease and insect problems); pasture nutrition; herbage-intake, digestibility and quality; pasture renovation; soil-fertility cycles; plant physiology and ecology; pasture management; pasture utilization; livestock production; feed-year trials, with pasture additives; and comparisons of whole-farm systems.

Liaison

Pasture research involves a multiplicity of disciplines and close liaison with Commonwealth and other State organizations; the CSIRO, Departments of Agriculture, Soil Conservation Services, Universities, and companies.

Close working relationships have been maintained with the CSIRO in staff training, lucerne research, lucerne breeding, the Yass Valley Organisation, use of pasture research facilities, plant introductions and exchanges, symposia, and breeder "workshops".

Liaison in herbage-plant cultivar matters has been organised through the N.S.W. Herbage-Plant Liaison Committee, which this year met at Sydney and Wagga and, by invitation, also met the Victorian Herbage Plant Liaison Committee in Melbourne.

A Forage-Plant Introduction Research Committee met at Tumut and Narrabri to co-ordinate pasture species programmes State-wide.

The Department is currently represented on a Commonwealth and States Sub-Committee to prepare a case for Australian entry in the O.E.C.D. Seed Certification Scheme.

Post-graduate Studies

Research agronomists have been encouraged to register with Universities for M.Sc. and other higher-degree studies on projects paralleling their Departmental responsibilities. Three pasture research agronomists are currently doing Ph.D. research projects (two in New South Wales) and eleven have registered M.Sc. projects.

International Grasslands Congress

The Department was represented by Dr J. Holder, Mr S. C. Grimmett and Dr G. J. Murtagh at the 10th International Grasslands Congress at Helsinki, Finland. Dr Holder presented a paper on "Production of dairy cattle from an improved pasture system in a sub-tropical environment" (author R. L. Colman, J. M. Holder and F. G. Swain); Mr Grimmett on "Development and utilization of spray-irrigated pasture for prime-lamb production in New South Wales"; and Dr Murtagh on "Interception of solar radiation and growth rate of a grass sward" (G. J. Murtagh and H. D. Gross).

Area Adaptive-Research Agronomists

District research agronomists continued in the Berry, Canberra, Maitland and Taree districts. Their relatively new category of research-extension work has gained increasing recognition.

The adaptive-research officer based on Canberra, in liaison with the CSIRO and the Yass Valley Organisation, conducted co-operative projects with the host organization. At Taree Berry and Maitland the adaptive-research officers received financial part-support respectively through a District Research Council, dairy factories, and a fertilizer company, and farmers and graziers co-operatively made land and stock available for trials.

At Berry a feature of the year has been the community provision of support funds, through the South Coast Agricultural Research and Extension Council, for employment of an additional research agronomist.

Illawarra Pastures

Area Research at Berry. Systematic evaluation of pasture species continued at Berry, towards achieving improved year-round pasture production for the many environments in the area. "Turoa", Montgomery and "Hamua" Broad Red clovers were outstanding in dry-matter yield, weed-suppression and production-constancy throughout the variable season; especially in mid summer when other clovers were relatively poor.

Louisiana white clover outyielded Ladino by 23-30 per cent at Berry on the more favoured locations, but Ladino's general value as a reliable component of the district's pastures was confirmed. *Setaria sphacelata* yielded well in association with a number of legumes including *Lotus pedunculatus*. The latter combined well to produce a balanced high-quality *Setaria* *Lotus* pasture.

Sub-Tropical Pasture Species

At Wollongbar. At Wollongbar a sub-tropical legume evaluation-project has been completed, and at four sites a study of subtropical grass-legume mixtures has been started. Under dry conditions in 1964-65 and 1965-66, grasses from the genera *Setaria*, *Panicum*, *Digitaria* and *Pennisetum* established more successfully than the sub-tropical legumes *Glycine*, *Desmodium* and *Siratro*. On a basaltic soil, "Kazungula" *Setaria* dominated the pasture, whilst, on a sandy soil, legumes produced more dry matter than the grass faction.

Siratro has established and built up well at Grafton from low-density stands.

Taree District. *Lotononis* appears to have a place in the Taree district. But the role of other sub-tropicals is not clear particularly in dairying areas. *Lotononis bainesii* has performed excellently on the upland podsolised-soils of the Taree district. It survived the severe 1964-66 drought, and responded well to occasional showers—much better than other sub-tropicals tested. *Siratro* proved well suited to upland soils and was easily established and drought resistant, but had a rather short growing-season.

Lespedeza striata (native) and naturalized white clover have given useful complementary grazing to *Siratro*.

Siratro has given good establishment and utilization on the steep upper slopes of a sandstone hill at Cattle Creek, Grafton. *Lotononis bainesii* has given good results on the mid-slopes whilst naturalized white clover has contributed well on the Paspalum/Carpet grass-dominated sandy-clay flats nearby.

All new introductions and promising species have been seed-increased, and a half acre isolation of "Israel" white clover p. 1354 has been established at Cangai. Seed-increase of *Setaria sphacelata* introductions have been arranged in co-operation with Brisbane officers of the CSIRO.

Species for the Clarence Valley. In an Upper Clarence River Beef Feed-year Project supported by the Australian Meat Research Committee, research on both finer-textured and coarser-textured soils has been started.

Promising species include naturalized white clover, strawberry clover, *Lotus major* and *Lespedeza striata*. Siratro and native *Glycine* species have responded well to superphosphate dressings and controlled stocking. Jemalong, Barrel medic (173) and Clare subterranean clovers produced well as annual winter-growing forage. *Lotus* species made good growth in the summer.

Siratro, Townsville lucerne and *Lotononis* have been outstanding for persistence, regeneration, spread and production on coarser-textured soils in the Clarence Valley. Lucerne, "Israel" white clover p. 1354, and Marrar subterranean clover were most promising in the winter-growing species trials.

Vetches. Golden Tares has proved a suitable and profitable source of high-quality late-winter early-spring feed on dairy farms in Taree district, and been used extensively on the far north coast as a late-winter to spring feed-source in the dairy feed-year. However, vetch diseases have been serious this season.

Lotus. Hairy canary clover (*Doryonium hirsutum*) since 1965 has shown promising survival, coupled with productivity when chisel-seeded into stony skeletal-soils in the Yass Valley.

Trials on the Shoalhaven flats and at Taree have indicated *Lotus pedunculatus* to be a promising species. *Lotus corniculatus* has done well at Walcha.

Other Pastures

Lucerne. Co-operative Department of Agriculture-CSIRO (Canberra) lucerne-cultivar trials and further selection in hybrid creeping-lucerne breeding-material have continued at Yanco and Narrabri.

At Maitland, sod-seeding of oats into established lucerne stands, to increase winter-feed availability, has given good results without prejudice to the lucerne stand for summer hay-production.

Phalaris. "Seasonal production-curve" studies with clovers and grasses and M.I.A. pasture mixtures have been concluded at Leeton. Further trials have been planned to investigate the seasonal winter- and summer-contribution of "Hybrid" phalaris, the newly-released "Sirocco" variety and "Australian", each in mixture with white clover and lucerne.

Wimmera Rye. Merredin wimmera ryegrass has performed superior to other grasses tested over the past three seasons, and is now being recommended for areas west of Temora.

Summer Grasses. Biloela buffel grass under dryland conditions at Narrabri recovered well from the drought of 1965-66. After good rain in spring, plants responded well to rising temperatures, grew vigorously and provided valuable grazing.

Oats and Various Grasses; Nitrogen Fertilization. A sod-seeding trial was started at Hawkesbury Agricultural College to compare, as a source of winter feed, various pasture grasses with oats when sod-seeded with nitrogen fertilizer into a white-clover sward.

Oats at high seeding rates and with high levels of nitrogen fertilizer application have made an excellent and reliable winter-feed contribution in coastal and tablelands districts.

Kikuyu; Nitrogen Fertilized. Kikuyu grass treated with high rates of nitrogen has contributed excellently to the dairy feed-year in coastal districts.

Salt-Tolerant Species. *Puccinellia capillaris* and *Agropyron elongatum* showed considerable promise on a salt-affected area in the Yass Valley.

Pasture Establishment Research

The "Good" Seedbed. The well-prepared, ploughed, disced, harrowed and compacted seedbed has given reliable establishment in Agricultural Research Stations' pasture sowings.

However, economic pressures, weed problems, erosion hazards and other factors have provided good reasons to attempt to perfect alternatives including band-seeding, cover-crop establishment, chisel-seeding, sod-seeding, aerial-seeding and use of "chemical ploughing".

Sub-tropical Species Establishment. A new project to investigate establishment problems of subtropical species has been started at Wollongbar.

Research on the establishment of temperate species into tropical species at Wollongbar has shown that *Lotus corniculatus* associates favourably with both *Glycine javanica* var. Clarence and Kikuyu.

Cover-crop Establishment. In a 1966 Temora trial even light cover-cropping (e.g. 15 lb wheat per acre sowing rate) markedly depressed both the yield and pod-set of the under-sown pasture. The trial will be continued to determine whether the initial disadvantage is overcome in succeeding years.

Spring sowings of phalaris and lucerne with a companion crop of a summer-forage species such as hybrid sorghums or Japanese millet gave satisfactory establishment in the Yass Valley despite a very dry later summer and autumn. Japanese millet proved more competitive than sorghum, and required more careful management to allow satisfactory establishment of the under-sown pasture species.

Band-seeding Drill Attachments. Lucerne nodulation and establishment trials showed promise for band-seeding and rolling treatments at Trangie, using special drill-tyne and press-wheel attachments.

Sod-Seeding. Variations in sod-seeder type and tyne-design have been tested at Grafton and Wollongbar. The "broad-cut" foot, the rotoseeder, and the standard tyne sod-seeders have been compared for large and small-seeded species. The "broad-cut" foot gave better establishment of small-seeded species weak in seedling growth and susceptible to shading as seedlings.

Aerial Pasture-Establishment/Improvement. Agricultural aircraft have opened up the opportunities for pasture improvement on non-arable hilly, timbered, or otherwise inaccessible grazing lands. Research, some of it in collaboration with fertilizer and agricultural chemical companies, has secured answers to problems in aerial species-establishment, reduction of competition by existing plant-cover, time of sowing, spraying, fertilizing, use of herbicides and insecticides, and control of "seed-theft" by ants. "Group Plans" pioneered by fertilizer companies, railways and aerial operators have improved the practicability and economics of "aerial" pasture-improvement.

Work on serrated tussock control at Bathurst has established principles of aerial sowing which have been applied to the problem of improving non-arable lands supporting native pasture. It has been shown at Rockley that legumes can be established into native pastures with little or no reduction of grass cover; although sown perennial grasses are more sensitive to competition from existing native grasses if the latter are not checked by use of chemicals or heavy grazing.

That work is having a big impact in tablelands districts. There are at least 14 million acres of readily-improvable high-rainfall country, where topography and timber-cover have been hitherto limiting factors on access for pasture improvement. Progress of aerial pasture-improvement promises to be a highlight in pasture improvement in the next decade.

Plant Nutrition Research

The main soil deficiencies in N.S.W. have been shown to include nitrogen, phosphorus, sulphur, potash, molybdenum, zinc, copper and boron. Study of soil deficiencies and fertilizer needs for optimum establishment and maintenance of pastures has been a major activity of the Department. Rapid increase in superphosphate usage on pastures, and increasing use of sulphur-fortified superphosphates and other more concentrated forms of phosphorus-supplying fertilizers, have necessitated more precise quantitative studies of phosphorus and sulphur needs in various regions.

Clarence Valley. Nutrition trials have shown the phosphorus status of Clarence Valley "upland" soils to be extremely low.

Native-pasture topdressing and cutting-frequency studies suggest a maximum attainable yield of only 1,400 lb dry-matter per acre. However, phosphorus uptake per acre was increased threefold by superphosphate additions. This could be significant in terms of beef-animal performance. Therefore grazing trials with beef animals are now being planned.

Hunter Valley. Research in the Hunter Valley has diagnosed a widespread soil-deficiency of phosphorus, nitrogen and molybdenum. In initial establishment of pastures 4 cwt per acre of superphosphate has been found desirable; with 2 cwt per acre satisfactory results in later years.

Temora. Zinc and molybdenum deficiencies have been confirmed on the red granite soils in Temora district. This at least part-answers the problem of subterranean clover's repeated failures on these soils.

Glen Innes. A diagnostic plant-nutrition trial has been established at Shannon Vale, in conjunction with soil sampling and analysis. This is to re-examine the nutritional status of soils after a long period of sown-pasture top-dressing.

Taree. Potash deficiency has been noted in Taree district. Soils tests and observations indicate that the deficiency could be widespread.

Yass Valley. Site-productivity studies have been started on an allegedly infertile "skeletal" soil and an adjacent porphyry soil, each subjected to application of 3½ cwt per acre of superphosphate zinc-boron-molybdenum fertilizer mixture. Perennial ryegrass was the most productive grass at both sites. *Phalaris* was low-yielding on the "skeletal" site.

Sub-Tropical Species Nutrition—Research. A new programme has been started at Wollongbar, to define nutrient deficiencies on various soils, to determine fertilizer needs for pasture establishment and maintenance of pasture under grazing, to assess nutrient status of species by plant and soil analyses, and to determine the basal nutrient requirements of grass under nitrogen fertilization.

Rock Phosphate Trials. Some trials have been done to determine the phosphorus-supplying capacity of low quality ("C" grade) rock phosphate over-burden at Christmas Island. Further trials have been initiated at Berry to compare rock-phosphate formulations with superphosphate as a phosphate source.

Pot-Trials for Diagnosis of Soil Deficiencies. Survey pot-trials have been done at Hawkesbury Agricultural College on soils from Bega, Bathurst, Mudgee, Taree, Goulburn, Muswellbrook, Temora, Wollongbar, Albury and other districts, to determine deficiencies. Main needs indicated are phosphorus, sulphur, potassium, calcium and molybdenum, and many of these have been confirmed in field trials.

Nitrogen Fertilizers; Increasing Use. Sound progress has continued with phosphorus, sulphur, potassium, and trace element nutrition of pasture species, but the most spectacular advance this year has been rapid increase in use of nitrogen fertilizers on oats, *Setaria*, Kikuyu grass.

The oats-objective has been to produce large quantities of winter feed. The Kikuyu objective has been to stimulate autumn-growth for carry-over into winter. Late-winter applications have helped to "start the spring" earlier.

Use of nitrogen to produce large quantities of feed on small acreages has allowed more flexibility in management, better establishment of subtropical species, greater opportunities to "save" feed, and reduced risk of feed shortage.

Pasture Management, Utilization, Supplementation: Livestock Production

Integration of Cereals, Pasture, and Livestock Production. Cereal cropping is increasing in importance on the southern tablelands, and in a co-operative project at Ginninderra Research Station the integration of cereal cropping and animal production is being studied: the effect of several grazing regimes on forage and grain yield of a range of cereals (wheat, oats, barley, rye) sown at varying times; and cereal cropping as a method of cover-crop establishment for clovers, grasses and lucerne.

Pasture Supplementation. Summer-forage species and variety trials were conducted at Glen Innes during summer 1966. Thirty lines of forage sorghum, grain sorghum, millets, and maize were compared. The hybrid forage sorghum appeared outstanding in production and value for beef cattle production.

Beef Feed-Year, Pasture Supplementation System. In a winter-nutrition breeding-project with beef cattle at Glen Innes, there was excellent winter-supplementation of pasture by grazing oats fertilized with sulphate of ammonia 2 cwt per acre. Utilization was by giving the breeding cows rationed access for 2-3 hours a day. The cows' weight increased through the winter and they were in good condition at calving. They received only one-third the supplementary feeding of the groups not oat-grazed.

Grain-supplementation of Pasture. Excellent results in butterfat production have been obtained at Grafton by supplementing with farm-grown shredded maize on a continuing basis throughout the year.

Feeding of an oat grain supplement to summer-calving cows grazing a *Glycine javanica*-Kikuyu pasture at Wollongbar increased butter production by 30 per cent, relative to cows unsupplemented on the same pasture.

Lucerne Management. At Tamworth, physiological studies on lucerne continued, for better understanding of the plant and its reactions under grazing. Systems of defoliation have been studied to determine effects upon root reserves and these in turn upon persistency and productivity of the stand.

At Trangie, a pilot trial on rotational grazing of lucerne completed its second year. It carried four dry ewes per acre during a first year, and in the second year the ewes were mated and carried 100 per cent of lambs through to weaning. Lucerne production has been maintained, with the lambs utilizing excess spring-growth. A 60 per cent increase in plant density has been recorded since this experiment began two years ago.

In a large-scale comparison of rotational grazing and set-stocking, at five wethers per acre, all lucerne plants were dead after seven months of set-stocking and some sheep died before the treatments were concluded. At two wethers per acre 90 per cent of the lucerne plants died under set-stocking, but plant numbers and sheep body-weights were maintained under rotational grazing.

At Tamworth, Trangie, Condobolin, Cowra, and Temora there are grazing-system trials wherein lucerne has shown its outstanding value as a grazing plant.

Quality of Pasture Species for Lamb Production. At Hawkesbury Agricultural College most pasture research in the past two years has aimed to determine the effect of the quality of individual pasture species on lamb-growth and development. Between species there have been marked inherent-differences in quality, measured in terms of lamb product. Weaner lambs grazed *ad libitum* on pure clover-swards grew faster and produced more meat and wool than lambs grazed under the same conditions on pure grass-swards. Species evaluated in these trials were Ladino white clover, *Bacchus Marsh* subterranean clover, *Phalaris tuberosa*, Grasslands Manawa ryegrass, Algerian oats and Japanese millet.

Recycling of Nutrients. At Shannon Vale there is pertinent research as to the effects of a scale of stocking-rates on the recycling of plant nutrients through the grazing animal, and the bearing of this upon "establishment", "build-up", and "maintenance" fertilizer needs of pastures.

The Shannon Vale results so far highlight the major effect of stocking-rate on nutrient balance and fertility needs of a pasture climax. They further confirm the need to introduce the animal, wherever possible, in pasture investigations.

Grazing Systems. In a comparison of a continuous-grazing system versus a 4-paddock rotational grazing system at Shannon Vale, at stocking rates of 4, 8, and 12 wethers per acre, no benefit accrued from rotational grazing at low stocking-levels. But at moderate stocking-levels there were appreciable benefits, approaching full utilization of available pasture-growth. At "stress" stocking-levels the production benefits of rotational management again decreased. Strategic rotational grazing reduced the amount of hand-feeding needed to maintain body-weight.

On a 4 x 10 acre paddock strategic rotational-system, 400 wethers produced 107 lb wool per acre last season at Shannon Vale.

Stocking Rates. A trial conducted from 1964 to 1966 at Leeton indicated that at high stocking-rates (6 ewes per acre) supplementation of the subclover/ryegrass pasture with summer pasture (paspalum/white clover) increased the sheep production per acre in an autumn-lambing situation. At low stocking-rates (3 sheep per acre) supplementation was of no benefit; three ewes per acre were safely carried by set-stocking on ryegrass/subclover pasture, and pasture availability greatly exceeded the animal requirements.

Sheep Stocking-Rates; "Per Head" and "Per Acre" Results. In a stocking-rate x superphosphate-rate trial at Shannon Vale the effect of stocking-rate was again dramatic in wool production: 49.2 lb per acre from 4 wethers per acre, 64.8 lb per acre from 8 wethers per acre, and 79.2 lb per acre from 12 wethers per acre. This was on *phalaris*-based pasture.

Wool Production on the Coast. In a pilot-experiment at Berry, 92 lb of wool per acre was produced by aged wethers at high stocking rates on Kikuyu grass pasture.

Effects of Grazing-frequencies and Nitrogen Levels on Sub-tropical (Grass-Legume) Pasture. Effects of nitrogen application-rates and grazing-frequencies on *Glycine*-Kikuyu pastures were studied at Wollongbar. *Glycine* yields were progressively lower with increasing nitrogen rates (0, 100N, 200N) and grazing-frequency (from 12, 8 to 4 weekly intervals). Total dry-matter yield increased with nitrogen application-rate.

Dairy Production Trials on Tropical Pasture (Legume-based). Tropical legume-based pastures were more productive in 1966-67 than in the previous year, giving higher production per dairy cow. Yield of butterfat per cow/per acre for "improved" and "unimproved" farmlets at Wollongbar were respectively 190 lb and 80 lb per cow/per acre in 1966-67, compared with 184 lb and 77 lb per acre in 1965-66.

A system including *Glycine javanica* and vetch produced twice as much butterfat per acre as the control farm. There was little difference in the production of spring-calved and summer-calved cows.

Addition of fertilizer nitrogen to a tropical legume-grass system further increased production, to a level about 2½ times that of the unimproved control. Again little difference was evident between the production of spring-calved and summer-calved cows.

In an experiment where 300 lb per acre of fertilizer nitrogen was applied annually in split dressings to a dominantly Kikuyu grass pasture, stocking-rate was a potent factor in determining production-levels. Production per cow decreased as the stocking-rate was increased but production per acre increased with stocking rate, from 158 lb to 274 lb of butterfat per acre.

Feeding an oat-grain supplement to summer-calving cows, grazing a glycine javanica-Kikuyu pasture, increased production by 30 per cent relative to unsupplemented cows on the same pasture.

Whole-farm Feed-year Studies. Whole-farm Feed-year research is measuring the economic impact of new research-findings and the value of new feed-year systems. The projects are also providing opportunities to assess the practical difficulties that arise in applying research-results on various types of property. Bankers have been interested observers of research-results, at Field Days, and banking institutions have contributed generously to the costs of conducting "whole-farm" projects.

Eight "whole-farm" research-studies have been initiated on the far north coast, and four more have been implemented by the Yass Valley Organization. There were initial set-backs, through drought in the 1964-65 and 1965-66 seasons, but encouraging production-gains have been achieved on all whole-farm projects.

Feed-year programmes on the north coast variously include winter pastures, sub-tropical pastures, oats x nitrogen, lucerne, Kikuyu x nitrogen, *Dolichos lablab*, Ladino clover, sod-seeded Golden tares, maize, and native pastures.

U.P.S.E.T. Trials

Range of Trials. Prepackaging of U.P.S.E.T. kits commenced again in autumn 1966, after one year's suspension. Trial-designs were reorganized, in co-operation with the Chemistry Branch and Biometrical Branch, and 16 types of trial were selected for use in 1967-68. These included six fertilizer-trials, including three designed to examine the response to various rates of fertilizers (potash; superphosphate; phosphorus, and sulphur), and two major and minor elements trials. A rate-of-potash trial introduced in 1965 was also retained, and a newly-designed potash-trial was added to diagnose potassium deficiencies.

Ten species-trials were arranged, including two new ones, testing phalaris varieties and early-maturing subterranean clover cultivars.

Five species-trials planned for the current year involve summer-growing species. They will be packed in winter 1967, to be available for planting in the spring. Three of them are quite new trials: sub-tropical grasses for dry areas, sub-tropical grasses for wet areas, and sub-tropical legumes.

Agronomists, by careful selection of appropriate trials, can now examine new species and strains and assess their likely value under District conditions before seed is readily available to local farmers.

Collation of U.P.S.E.T. Results for Publication. Compilation of an index of all results from U.P.S.E.T. since 1959 has been completed. A grant from the Sulphur Institute has assisted the compilation of U.P.S.E.T. fertilizer-trial results for publication.

Use of U.P.S.E.T. in Agronomists' Districts. Eighty-nine fertilizers-trials and 190 species-trials were pre-packaged and sent to District and Research Agronomists, and 56 summer species-trials will have been packaged and despatched by the end of July, 1967.

In 1963-64, there were 213 fertilizer-trials and 241 species-trials, a total of 454; in 1964-65 there were 293 fertilizer and 214 species-trials, a total of 507; and in 1965, the pre-packaging of trials was suspended.

Besides providing information on species-suitability and fertilizer requirements on various soil types, the U.P.S.E.T. trials have been useful extension aids and the basis of numerous field days.

Appointment of field assistants, through availability of Commonwealth Extension Grant funds has enabled District agronomists to undertake increased experimental and demonstration work to provide local extension-information. The pre-packaged, well-planned U.P.S.E.T. material has greatly reduced the time and work needed to establish trials and also facilitated the co-ordination of results.

Pasture Demonstrations

Recommended practices, and varieties of pasture plants, have been demonstrated in 64 projects financed by funds from the Commonwealth Extension Service Grants. Subject-matter of the demonstrations included: the heat-tolerance, persistency and drought-resistance of Kangaroo Valley ryegrass, compared with other ryegrasses; the suitability of Demeter fescue in tablelands districts; and the value of summer legumes (*Siratro*, *Desmodium* sp., *Lotononis*, and *Glycine javanica*) on the north coast. Fertilizer, establishment, inoculation and trace-element recommendations have been demonstrated in each.

Lotononis bainesii has been demonstrated as promising on coastal sandy-wallum soils.

At one Demonstration site at Grafton a farmer has lifted butterfat production from 8,855 lb in 1963-64 to 18,506 in 1965-66, by a combination of improved pastures (including Kazungula *Setaria* and *Desmodium uncinatum*), maize-grain feeding and good feed-year planning.

Demonstrations on the north coast have emphasized the need to adopt lenient-grazing management of summer-legume stands in the first year, to achieve legume-dominance.

A demonstration at Warrall Creek included a round-the-year mixture of *Paspalum wettsteinii*, *Desmodium uncinatum*, *Trifolium repens* and *Lolium perenne* (K.V.). It was set up to show the value of nitrogen fertilizers used strategically to obtain seasonally-needed feed in autumn-winter and early spring.

Superior winter-growth of African and Hairy Peruvian lucerne has been demonstrated in some coastal dairying districts; but the greater persistency of Hunter River lucerne has also been apparent.

Increased winter-feed availability has been demonstrated in coastal dairying areas as a result of using oats-nitrogen.

Techniques for lucerne establishment, including inoculation and lime-pelleting, have been successfully shown at Tenterfield; also the value of lucerne rotational-grazing has been demonstrated.

Demonstrations of cultivars of perennial temperate-grasses, including phalaris and cocksfoot have been established in tablelands and coastal districts.

Pasture Seed Production

Good spring and summer rains following the severe drought of 1965-66 led to remarkable recovery in pasture-seed production. A total of 2,664 tons of pasture seeds have been certified to 30th June, 1967, with a further 300 tons expected to complete the season. Uncertified and non-certified seed would add considerably to this total.

The main species harvested for seed were varieties of subterranean clover (2,254 tons), New South Wales *Phalaris tuberosa* (195 tons), Seedmaster *Phalaris tuberosa* (21 tons), Kangaroo Valley perennial ryegrass (121 tons) and Demeter fescue (50 tons). Mt Barker continued as the dominant subterranean clover, but Marrar increased from 10 per cent of the crop in 1965-66 to 30 per cent of it in 1966-67. Tallarook increased to 60 tons, but Clare remained in short supply.

Under field conditions a 30 per cent increase in seed yield has been achieved by Seedmaster compared with New South Wales commercial phalaris. A new cultivar of *Phalaris*, "Sirocco", has been grown in Foundation seed grade this year.

Kangaroo Valley perennial ryegrass seed achieved a record harvest of about 2,500 bushels. Rapid advances have also been made in the production of Demeter fescue, at Cowra and Glen Innes. Seed growers failed to take opportunities offering in Brignoles and Currie cocksfoot seed-production.

Three new varieties were added to New South Wales Certification Schemes: "Cyprus" barrel medic, "Sirocco" *Phalaris tuberosa*, and Warrall grass (*Paspalum wettsteinii*).

This good progress in pasture seed-production has been aided by co-operation with the New South Wales Seed Growers' Association, the New South Wales Seedmen's Association and the New South Wales Seed-Increase Committee. An important role has been played by the New South Wales

Herbage-Plant Liaison Committee; in welding ideas generated by commercial, Commonwealth, university and State interests towards solving seed-production problems associated with new and unique Australian cultivars.

Seed Certification officers met the demands exerted by the increasing number of varieties and the complexities of certification requirements introduced by pedigree systems. Over 48,000 acres were inspected and 81,458 sacks were paddock-sealed, comprising 1,166 lines.

PASTURE SEED CERTIFICATION, 1966-1967

	Sub. Clover	Phalaris Tuberosa		Kangaroo Valley Ryegrass	"N.S.W." Perennial Ryegrass	Cocksfoot		White Clover	Demeter Fescue	Barrel Medic	Totals		
		"N.S.W."	"Seed- master"			Brig- noles	Currie				1966/7	1965/6	1964/5
Areas registered.....	370	231	54	54	15	15	32	3	16	5	789	660	641
Lines sampled and tested	588	312	44	148	7	12	23	0	27	5	1,166	565	793
Tons of seed finally sealed	2,254½	195	21½	121	4	1	2½	0	50	14	2,664	1,041	2,550½



Inspecting "Phalaris Seedmaster" mother-seed area at Cowra

Under field-conditions, "Phalaris Seedmaster" has achieved 30 per cent increase in seed-yield compared with New South Wales commercial phalaris

SEED TESTING LABORATORY

The work-volume of the Seed Testing Laboratory, as measured by numbers of samples tested, increased by 2.3 per cent in comparison with the previous year. Of the 3,261 samples received, some 650 were examined on behalf of the Commonwealth Quarantine Authorities and 1,540 in relation to seed certification standards. There was a 97 per cent increase in certified pasture-seed samples, compared with the previous year (drought-affected).

Seed-production activities with maize, cotton and vegetable crops were also serviced by seed-testing.

Tests were done for and other assistance given to seed firms, boards and statutory bodies, farmers, members of the public, the police, Customs and Railways Departments; regarding seed-viability, purity and identification.

INSPECTIONS UNDER VARIOUS ACTS

Three inspectors continued duties throughout the State under the Agricultural Seeds Act, Stock Foods and Medicines Act, Pest Destroyers Act, Fertilizers Act, and Veterinary Surgeons Act. They visited 134 towns, made 654 inspections and took samples in 62 cases. Eleven prosecutions were conducted.

Detected unregistered products included 740 stock medicines, 99 stock foods, 124 pest destroyers, and 28 fertilizers. Warnings were sent to firms responsible for unregistered products on the New South Wales market, and also to shops retailing these products.

The inspectors have been engaged part time on seed certification duties.

Cereals Work

WHEAT

Record Wheat Acreage and Production

Acreage, production and yield per acre in New South Wales exceeded all previous records. Total grain-production was estimated at 200,000,000 bushels from 6,800,000 acres sown for grain, at a yield-average of 29.4 bushels per acre and valued at \$298,097,000. Previous highest grain-production was 151,483,000 bushels in 1964-65. Total sowing for all purposes in 1966 was 7,000,000 acres.

Wheat harvesting finished about mid-February, 1967; the latest for many years. Deliveries to the Wheat Board as at end of May, 1967, in New South Wales, totalled 183,722,000 bushels; 177,080,000 bushels in bulk (96 per cent), and 6,642,000 bushels bagged. Of this total, 16,630,000 bushels received a premium, and 34,002,000 bushels were classed as off-grade.

In addition, about 7,000,000 bushels of New South Wales wheat was delivered to the Wheat Board in Victoria from southern stations operated by the Victorian Railways. The remainder of the estimated harvest, at least 9,000,000 bushels, is being held on farms for seed, feed, or later delivery to the Wheat Board.

Premium Wheats

Local premium-wheat payments by millers reached \$557,922 (to 5th March, 1967) on a total of 3,614,174 bushels. In the previous year the respective figure was \$661,186 and 1,970,598 bushels.

The greatest quantity of local premium-purchases from the 1966-67 crop comprised hard bread-wheat varieties (2,219,476 bushels). Soft-variety local premium sales totalled 1,201,334 bushels. Premiums were paid on 193,364 bushels of durum wheat.

The premium-averages were: for hard bread-wheat varieties 19.67c per bushel (53.63c in 1965); for soft varieties 4.57c (6.45c in 1965); and 34.36c for the durum wheat Dural. The highest premium was 44c, for a parcel of Mendos. In the previous year \$1.05 was the highest premium.

Highest premium-averages were paid for Gamenya (35.44c), Gala (20.31c), and Koda (20c).

The most popular hard bread-wheats, as gauged by premium acceptance-quantities were: Mendos 40.38 per cent; Gamenya 12.86 per cent; Gamut 8.15 per cent; Mengavi 7.13 per cent; Festiguay 6.15 per cent; and Falcon 5.72 per cent. These six totalled almost 80 per cent of the hard bread-wheat premium deliveries.

Premium-wheat delivery-quantities of the durum variety Dural were easily a record. Premiums totalling \$66,456 were paid by local millers, on 193,364 bushels; a premium-average of 34.36c per bushel.

Pinnacle accounted for almost 77 per cent of the soft-variety deliveries commanding local premiums. The premium-average for soft varieties was considerably less than for hard bread-wheats and durums.

Besides the aforementioned quantities of premium wheats, 12,900,000 bushels of wheat tested for protein was received at selected receival-points for ultimate local or overseas sales.

F.A.Q. Standard

Two f.a.q. standards were declared by the N.S.W. Wheat Standards Committee; one for northern, and one for southern and western combined. The f.a.q. for northern (related to wheat to be exported from Newcastle) was declared at 63 lb per bushel schopper-weight, and that for southern and western combined (related to wheat to be exported from Sydney) at 62½ lb per bushel. In the previous year, when wheat from northern areas was negligible because of the drought, only one standard was declared—for southern and western wheat combined—and this was 63 lb per bushel.

The Committee also determined standards for prime hard (premium wheat), northwestern off-grade, and southern-western off-grade; as yet the greatest number of separately-handled bulk-grades in the State and, in effect, a further extension of segregation.

Both northern and southern-western f.a.q. samples were clean and attractive and noticeably free from wild oats.

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Wheat Variety-Popularities

Variety statistics for the 1965-66 season (the latest available) show a bias in favour of southern varieties. This reflects the reduction in the northern acreage sown to wheat, because the drought was much more severe in the north.

The four most popular varieties were as in the previous season. Heron increased from 19.8 to 26.6 per cent of the total acreage, Falcon from 11.2 to 15.6 per cent, and Olympic from 10.5 to 14.3 per cent; but Gamenya decreased, from 9.8 to 7.3 per cent. Gamenya, of course, is grown mainly in the northwest.

Two varieties rapidly increasing in popularity are Mendos (13.5 per cent and in seventh place) and Festiguay (2.1 per cent and in tenth place). Each was released as recently as 1964. Other varieties which increased their percentage were Insignia and Pinnacle.

Varieties less popular in 1965-66 than in the previous season were Mengavi, Glenwari, Bencubbin, Bordan, Eureka, Festival, Gabo, Sabre, Spica, and the winter wheats Winglen and Windebri.

Wheat Variety Recommendations

The main change was replacement of Gamenya by Gamut in some rust-labile northern areas. Gamut was added to the recommended mid- to late-sowing varieties in the main northern wheat belt: north of a line between Merriwa, Binnaway, and Baradine. Gamenya was deleted from recommendations for the same areas.

Gamut was added to recommendations in rust-labile portions of the Western Agricultural Regions, north of a line approximately between Dubbo, Narromine, and Trangie.

In making these recommendations the Standing Advisory Committee on Wheat emphasized that Gamut and Gamenya each had some disabilities which northern growers should consider when planning this season's sowings.

The suggested inclusion of Gamut in recommendations for the north follows information from numerous trials conducted in 1966. In yield, Gamut compared favourably with Mendos and Festiguay under most conditions, and where rust was a limiting factor it outyielded Gamenya. Where rust was not a known limiting-factor, Gamenya outyielded Gamut in most trials. Gamut is resistant to all prevalent strains of stem rust, and mainly for this reason it was proposed for inclusion in recommendations this year. Under favourable finishing-conditions, particularly in more marginal wheat-areas Gamut may suffer reduced bushel-weight. Under some conditions the ripe crop may suffer some yield-loss due to shedding. Milling and baking quality of Gamut is satisfactory and in the Gabo class.

For practical purposes Gamenya is now completely susceptible to stem rust and its continued production in the north could make difficult the task of breeders in producing new rust-resistant varieties. Because it continues to yield well in other parts of the State where stem rust is less of a hazard, Gamenya is retained in recommendations there.

Winter Wheats

Below-average rainfall in the first six months of 1966 resulted in less than normal acreage sown to winter wheats. In localities where early rain was enough for establishment, the Departmental winter-wheat varieties Winglen and Windebri were sown, mainly for grazing. However, little grazing was obtained because of following dry conditions. Grain yields were satisfactory because of late rains. Premiums were paid for a small quantity of grain of the two varieties.

Durum Wheats

Production of durum wheat in the north expanded in 1966-67. More than 8,000 acres were sown, and more than 200,000 bushels was produced. Grain quality was the best ever. Samples had up to 19 per cent protein content. All sales were at premium prices; local millers paid \$66,456 in premiums on 193,364 bushels, a premium-average of 34.36c per bushel.

Demand for durum products continued to increase. The main millers of this grain expect an acreage of more than 10,000 in 1967.

Wheat Quality

The Chemistry Branch co-operated in quality-testing of new wheat varieties tested on Research Stations and private farms. Some 700 samples were supplied for testing. Also, a number of collaborating laboratories did the uniform-quality

testing of three promising crossbreds: one from the northern and two from the southern programmes. Depending on final yield and quality-test data, one or more of these lines may be considered for release.

Bench characters of wheats in the open classes at the 1967 Royal Easter Show were judged by the Cereal specialist. Fifty-five samples were entered, as against 48 in the previous years. The best samples in the main classes were of a high standard, but in general the quality on the bench was the worst for some years. Top bushel weight was 68½ lb for a Spica entry. The best varieties, in the respective class, were the Departmental varieties Festiguay, Falcon, and Heron, and the Queensland variety Spica.

Entries, in order of variety-popularity, were: Olympic (12), Gamenya (10), Falcon (8), Mendos (7), Festiguay and Heron (6 each), Spica (4), Wingen and Dural (one each).

Wheat Experiments

Variety Trials. Randomized and replicated trials of varieties were arranged with 69 farmers (66 in 1965-66), working under the supervision of 21 (20) District agronomists and testing a total of 18 (16) varieties. Also, wheat-variety trials were conducted on six Research Stations and in these a large number of promising crossbreds and new varieties were compared with standard varieties. Because of the good season 94 trials were harvested, whereas because of the drought only 56 trials were harvested in 1965-66.

Variety Performances in Trials. New varieties under test in the north included Mendos, Gamut, TR135, and M8127. Gamenya continued to give the best overall yields where stem rust was not a limiting factor. Of the other main named varieties, Mendos, Festiguay, and Gamut were about equal in yield and Spica a little inferior. The new University line TR135, which has a five-factor resistance to stem rust and a photoperiod response to ear-initiation, yielded about equal to Gamut, Mendos and Festiguay. The new rust-resistant Tamworth line M8127 compared well in yield with Gamenya but was in very few of the trials.

In central and southern areas Olympic was the best of the standard varieties. Falcon performed better than in the previous season, when frost and drought reduced its yield. Gamut yielded very poorly and can be rejected from further testing in these areas. The semi-dwarf line NB Javelin 115 yielded extremely well in all trials but seems best suited for better rainfall areas and under irrigation. KF Heron also performed well, compared favourably with Heron, and is undergoing final yield- and quality-tests prior to recommendation. The new Victorian variety Summit was tested for the first time and although inferior to Olympic it compared favourably with Pinnacle.

Soil Fertility and Rotation Experiment. This trial, at Condobolin Research Station, completed its eleventh year.

The first half of the year was fairly dry, enabling only one grazing of the annual pasture plots and two grazings of the lucerne plots in this period. The grazing oats had to be sown into a dry seedbed but good rain two weeks later led to satisfactory germination. There were three cuts in the season and good yield overall.

Yields from the wheat plots were very satisfactory, varying from 30 to 40 bushels per acre. Once again, yield from the long fallow plots was greater than from medium and short fallows. The highest yields were in plots sown after lucerne; followed by plots sown after annual improved-pasture and grazing oats. Yields from the grain-oat plots were also good, varying from 39 bushels per acre on short fallow to 43 bushels per acre after medium fallow.

Improved-pasture and lucerne sowings were successfully made. Skeleton weed and barley grass are becoming a problem throughout the trial area.

Other Rotation Trials. The results of the stubble-treatment trial concluded at Temora Research Station some years ago are being considered for publication.

Wheat Fertilizer Trials. In the north most of the work on response of wheat to phosphorus has been completed. The results are being analysed in preparation for publication.

Trials have been initiated in co-operation with the Plant Breeding Section at Tamworth Research Station to determine the response of varieties to both phosphorus and nitrogen. Standard varieties and unnamed promising crossbreds are included. In addition a number of trials have been commenced under irrigation.

In central New South Wales the wheat nutrition programme, based at Condobolin Research Station, completed its third year. In contrast to 1965, when only 15 trials could be harvested,

32 trials were harvested in 1966. By the end of 1968, data from a sufficient number of trials for a completely satisfactory correlation test will be available. By that time there should also be a satisfactory soil-nitrogen test.

A new fertilizer research programme, based at Cowra Research Station, was commenced in 1966. Twelve trials were harvested. Because of the general use of subterranean clover in rotations in the eastern part of the central west, no nitrogen response was obtained in any.

Wheat fertilizer trials have been sown at Trangie Research Station. This is in anticipation of appointment of an agronomist in 1968 to carry out a full-scale fertilizer research programme to serve the northern part of the central west.

Field Wheat Competitions

Six Divisional Championships were conducted in 1966 by the R.A.S. Most of the local and all of the Championship judgments were done by officers of this Department. Total of crops judged was 951, in 83 local competitions; as against 295 crops in 1965, in 31 local competitions, and 859 crops in 1964, in 80 local competitions. Entries in some local competitions were pre-judged by farmer-judges, reducing the local total to the maximum of 10 crops allowed to be judged by Departmental officers.

The Departmentally-bred varieties Festiguay and Falcon fared well in the competitions, as shown by the following statistics:

Division	Local Competitions	Local Entries	Championship Crop	
			Variety	Est. Yield Bsh/acre
Northern	12	111	Festiguay	55
Northern Slopes	13	158	Festiguay	62
Western	16	209	Falcon	54
Central Slopes	16	166	Falcon	61
Riverina	13	188	Olympic	52
Southern Slopes	13	119	Olympic	55
Total	83	951		

OATS

Record Acreage and Production

In 1966-67 a record crop of oats was harvested; an estimated 30,000,000 bushels, from a record harvested area of about 1,200,000 acres, at a yield-average of 25 bushels per harvested acre and valued at \$27,000,000. Hay production was estimated at about 125,000 tons from 90,000 acres at an average yield of 1.4 tons per acre.

The total area sown for all purposes in 1966-67 was estimated to be a record 2,000,000 acres. About 710,000 acres was used for grazing. Dry weather in the first half of 1966 severely stressed crops sown early for grazing, particularly in the north, and limited the grazing available from central and southern crops. Good rains late in the season caused vigorous growth. Harvest rains lodged heavy crops, and lowered the grain quality.

Oat Variety-Popularities

The latest available oat variety statistics (for 1965-66) showed some important changes, but the results overall were distorted by drought effects in the northwest—where the acreage sown was low. The distortion favoured the southern varieties such as Cooba and Avon.

Belar, the most popular in N.S.W. for over 30 years, fell from first place in 1964-65 (18.1 per cent of the acreage) to third place in 1965-66 (13.1 per cent). Cooba, released only in 1961, rose from second place in 1964-65 (14.6 per cent) to first place in 1965-66 (22.6 per cent). Cooba has become very popular in central and southern areas, as a dual purpose variety for early sowings. Avon was the second most popular variety with 17.6 per cent of the acreage, compared with 14.2 per cent in 1964-65. Avon is popular in southern areas for grain recovery after light grazing and is usually sown mid-season. Algerian maintained fourth position with only a slight fall, from 13.4 to 13.0 per cent of the total acreage.

Fulghum, Fulmark, Dale, Acacia, and Ballidu receded slightly in percentage of area, while Orient showed a slight increase.

Oat Variety Recommendations

Mugga, a new variety bred at New England Agricultural Research Station, was added to recommendations for the higher parts of the Northern and North Western Agricultural Regions, to replace Algerian. The main advantages of Mugga in those regions are its relatively strong straw, resistance to smut, and resistance to frost damage after grazing.

Bundy, because of overall good performance, has been added to recommendations in some other regions.

Oat Experiments

Variety Trials. Randomized and replicated oat-variety trials were arranged with 40 farmers working under the supervision of 20 District agronomists and testing a total of 13 varieties. Variety trials were conducted also at eight Research Stations and in these a large number of promising crossbreds and new varieties were compared with standard varieties.

Oat Variety Performances in Trials. The crossbred M1115 (Fulmark x Ballidu) x (Dale x Fulghum) bred at Temora Research Station performed quite creditably in trials and is undergoing final tests prior to recommendation. It is a dual-purpose variety, producing quick early-growth if sown late (April) and with a very good recovery for grain. It can also be grown for grain only.

The season was very favourable for Cooba. Because it could be sown early it produced a large bulk of fodder over the winter, and the good spring enabled excellent recovery of grain.

Bundy continued to do well. It gave best results when grazed leniently and then allowed to recover for grain.

Oat-Improvement Programme and the North. The northern oat-improvement programme is in abeyance pending appointment of a replacement oat-breeder.

Rates of Seed and Fertilizer, Grazing Oats. The trial to determine the effects of nitrogenous fertilizer, for green fodder and grain-recovery of oats, at two different times of application, and at two different sowing-rates was carried out at Glen Innes during the year. A basal application of 1 cwt/acre of superphosphate was applied. Two grazing-cuts were made and no significant difference was obtained. The plots were then allowed to recover for grain. A significant difference was recorded for grain recovery.

Temora Research Station trials showed under southern slopes' conditions no response to application of nitrogenous fertilizer if soil fertility has been built up by a period of subterranean clover.

BARLEY

Record Acreage and Production

Interest in barley for feed grain and for malting purposes continued. Final statistics are as yet not available but it has been estimated that grain production in 1966-67 was a record 8,000,000 bushels, valued at \$10,290,000. Previous record barley-acreage and production were in 1964-65, when sowings for all purposes totalled 273,799 acres, with 34,093 acres used for green-fodder production and 238,983 acres harvested for a grain yield of 6,707,100 bushels. Of the total 1964-65 yield, 4,040,460 bushels were of 2-row grain and 2,666,646 bushels of 6-row grain.

Protein content of much of the northern barley in 1966-67 was appreciably higher than normal, and this led to some instances of non-acceptance for malting purposes. Quality otherwise was good, apart from some staining caused by harvest rains. Establishment of a barley malting-plant at Tamworth in early 1967 has created more interest in the crop in the north.

Barley Experiments

Variety Trials. Randomized and replicated variety-trials were arranged with 17 farmers (15 in 1965-66), working under the supervision of 14 (12) District agronomists, testing a total of 10 (10) varieties. Trials were conducted also at Wagga Agricultural College. A total of 14 trials were harvested.

Variety Performances. The season favoured the late-maturing varieties because of the good spring and early summer. Proctor, a late-maturing malting-variety popular in Tasmania, was the top yielder at a number of centres. Abyssinian, a consistently good yielder, did creditably. Beecher, a fairly new introduction from Western Australia, maintained its good yielding.

CEREAL GRAZING TRIALS

The cereal grazing trial at Cowra Research Station has been concluded. The results are being prepared with view to publication.



Big area of flood-irrigated maize near Quirindi, North Western Region

Irrigation-farming in North Western Region has notably expanded; stimulated in part by the drought and by better knowledge of underground water resources and irrigation methods. In the Breeza-Quirindi sector, flood-irrigation has increased to 4,000 acres; mainly for maize so far. But 50,000 acres there could be irrigated, and oil-seed crops and large-scale vegetable-production are likely trends

A similar trial was conducted at Glen Innes Research Station some years ago. The results of this have been incorporated in an article on "Oat Growing on the Northern Tablelands" published in the *Agricultural Gazette of New South Wales*.

CEREAL PURE-SEED PRODUCTION

Supplies of pure seed of recommended and promising varieties of wheat, oats and barley were maintained on eight Research Stations and distributed through Registered Seed Growers throughout the State. In 1966-67 Foundation Seed sowings on Research Stations totalled 67 acres of wheat (62 in 1965-66), 85 (34) acres of oats and 28 (20) acres of barley. In addition, and associated with those sowings, initial selection and preliminary-increase of wheat and oats were done at Temora Research Station and of barley at Wagga Agricultural College.

A total of 267 Registered growers participated in the Registered Seed Scheme in co-operation with the Department, and disposed of large quantities of pure seed to other growers in 1966-67. In all: 137 Registered Seed Wheat Growers (139 in 1965-66) working under the supervision of 22 (22) District agronomists throughout the wheat belt, using Foundation Seed supplied by this Department, undertook seed increase of 14 (13) varieties; 106 (93) Registered seed oat growers in 24 (23) District agronomists' areas seed-increased 12 (15) oat varieties; and 24 (22) Registered seed barley growers undertook pure-seed production of 8 (7) barley varieties in 14 (13) District agronomists' areas. Because of the good season ample seed of most varieties was produced for sale to other growers.

CEREAL RYE

Increased Acreage and Production

The latest-available production-statistics are for the 1965-66 season, when 12,000 acres of rye were sown for all purposes and 9,500 were utilised for green fodder or hay. In that year, 60,350 bushels of grain were harvested from 4,596 acres.

A marked acreage-increase occurred in 1966-67 and it is estimated that grain production may have reached 130,000 bushels. The increase sowings resulted from a guaranteed price offered by a firm of millers for grain contracted.

In early 1967 there was a good enquiry for rye seed, but acreage may decline because of a possible grain-carryover from 1966 and the dry first half of 1967.

The Department maintained basic seed stocks of the varieties Weethalle and Strain 8, and distributed seed of each to co-operating farmers for seed-increase and general distribution to other growers.

MAIZE

Acreage and Production

The maize-acreage expanded by about 20 per cent. There was a greater appreciation of the crop in inland irrigation and coastal districts where large-scale use of hammer-milled grain for supplementary feeding of dairy herds continued.

Growers were more conscious of the need for higher plant-populations and adequate fertilizer. Use of ready-mixed fertilizers and anhydrous ammonia increased two-fold and aided yields.

Although flood conditions at maturity reduced coastal-crop yields and inefficient irrigation affected some inland crops, the total area harvested for grain was above average. It was estimated as 60,000 acres, with a total yield in excess of 2,500,000 bushels.

There were yields of 200 bushels per acre from some inland areas, and record yield-averages of 60-70 bushels per acre were expected in some coastal districts.

Large-scale inland-operations continued; 600 acres of maize were furrow-irrigated on one property, for a yield-average of 100 bushels per acre.

Mechanical harvesting of maize was general. Picker thresher machines were more widely used. With this harvesting method, grain-drying received more attention. Electricity, gas and oil were used to dry grain.

A lower than normal maize-grain price led to greater grower-interest in marketing, and a Maize Growers' Co-operative was formed at Quirindi. The irrigated maize area there has increased to 2,500 acres in three years. At the end of the season Sydney grain-merchants were seeking 50,000 tons of grain for export to Japan.

Waxy Maize

The acreage of waxy maize hybrid N.E.H. 1215wx sown under contract to a starch manufacturer doubled, and waxy grain production was estimated at 1,500 tons. The use of waxy starch by canners was firmly established and new industrial uses for the starch increased the demand. The seed acreage planted to N.E.H. 1215wx was trebled to 16 acres.

Maize Nutritional Disorders

Nutritional disorders became more apparent as maize growing extended to newer areas. Zinc deficiency was a problem on the heavy soils of the plains where high pH, high humus and levelling for irrigation induced the ideal environment. Crop-spraying with zinc sulphate, plus seed-dusting with zinc oxide, was the Department's recommendation and became common practice. A treated zinc-deficiency area of the Breeza Plain yielded 170 bushels per acre, as against 9 bushels per acre from an untreated area.

Molybdenum deficiency was again a problem on some north-coastal soils; accentuated by dry soil conditions. Crop spraying with sodium molybdate rectified it, but attention to molybdenum-level in hybrid-maize seed continued.

Hybrid Maize Improvement Programmes

A programme to improve early- and late-maturing hybrids was conducted respectively at Glen Innes and Grafton Research Stations.

At Grafton, areas were flooded and the breeding work was setback for the third successive year. Breeding-material was exchanged with France and Greece while inbred lines, most of American origin, were introduced for incorporation into the breeding programme.

Two hundred and eighty yellow inbreds and thirty-two white inbreds were maintained at Grafton. Testing of inbreds for combining-ability continued, and seventeen with late to midseason maturity were taken to the advanced-testing stage.

At Glen Innes, inbred N.E.3, a local derivative of K4, again showed high lodging-resistance while some selections of the inbred B15 were completely free of the barren-stalk anomaly. Three recent introductions from Iowa, B59, B60 and HD2271, showed promise. The HD2271 had very good stalk-strength.

Derivatives of C103 and B15 were advanced through a further selfing-generation and a few crosses were made with these lines.

Open-pollinated varieties from State-wide grower sources were screened for inbred development, and selections representing various levels of inbreeding were advanced a further generation.

A few lines from the older open-pollinated varieties Wellin-grove and Golden Glow were taken to the sixth generation at Glen Innes, while at Grafton four new inbred lines were fixed for naming.

Attention was given to improvement of the waxy hybrid N.E.H. 1215wx. Waxy inbreds were imported by a private company and handled by the Department in quarantine. A double fertilizer technique to develop non-reciprocal cross sterile waxy inbreds was started at Glen Innes, and recoveries were obtained from all inbreds handled.

There was full co-operation between the Queensland and New South Wales Departments in breeding-programmes, and material was exchanged. The New Zealand Department was assisted also, and a full range of early-maturing hybrids was made available to it for testing.

Interest was maintained in the development of special-purpose hybrids and action was taken to obtain high-lysine lines from U.S.A. for use in the breeding programme. High amylose maize was investigated and arrangements were made to import breeding-lines with high amylose.

Male Sterility Programme

Conversion of inbreds to the male sterile and restorer forms continued. The converted lines C121 MS, FF1, MS, M1MS, Y1 MS, 13B MS, 21 MS, 23 MS, 25 MS, 61A MS, 68 MS, C17 R, 23R and 25R were maintained while, from a further 25 inbreds being converted eleven were taken to the seventh backcross and eight to the sixth backcross.

At Glen Innes, fertility-restoring forms of the inbreds K4 and C103wx were isolated. Seed of C103 MS and S103A MS (selected for its non silk-balling characteristics) were produced.

N.E.H.1151, produced by the male-sterile method, was compared in field trials with the hybrid produced by detasselling. There was no significant yield-difference.

All commercial G.H.128 and N.E.H.7 maize areas sown were with seed produced by the male-sterile method. Field performances were very satisfactory.

Inbreds 25R and 23R, the pollinators for hybrid G.H.128, were again very difficult to handle because of variability in tassel-fertility.

Seed-production in the inbred forms and in the single-cross form (25R x 23R) were light and difficult. However, it was much better when the single cross was advanced to the F₂ stage, and sufficient F₂ seed was produced to continue G.H.128 hybrid seed-production.

Improvement of the fertility-factor in inbreds 25 and 23 was taken a step further at Grafton.

All seed-production of hybrid G.H.128 was with inbred material converted to the male-sterile and restorer forms (Y1MS x M1) (25R x 23R). A breakdown in sterility of Y1MS x M1, ranging from nil to 5 per cent level, caused concern to seed growers. In some cases, seed crops sown with the male-sterile material had to be detasselled. Y1MS seed stocks proved satisfactory when tested, but single cross Y1MS x M1 lines showed some fertile tassels. This anomaly did not occur when the same material was used a year earlier.

Investigations were commenced, into the possibility of an environmental influence and a mutant with fertility-restoration factors in the M1, but these were confined to glasshouse-sowings.

Hybrids Resistant to Leaf Blight

Very little loss occurred from leaf blight (*Helminthosporium turcicum*) in coastal crops but breeding for resistance continued.

The co-operative programme between Glen Innes and Grafton Research Stations to develop early-maturing blight-resistant hybrids was maintained, and F₂ progenies of crosses between early inbreds and blight-resistant late-maturing inbreds were sown in a blight-nursery at Grafton. Inoculations were made but, for the second successive year, the disease failed to develop sufficiently for effective selections.

Backcrossing of material involving elite early-maturing inbreds and the American line "Source B" containing the dominant single gene for blight-resistance continued.

Hybrid Maize Trials

Eleven trials with late-maturing hybrids, thirteen with midseason-maturing hybrids and eleven with early-maturing hybrids were conducted with co-operative farmers, as an aid to the breeding programmes.

Hybrids G.H.128 and G.M.211 continued to do satisfactorily in the late-maturing group, while there appeared to be little difference in yielding ability between the commercial DeKalb hybrids D.S.28, D.S.606A, D.S.601 and the Departmental hybrids N.E.H.7, N.E.H.1151, N.E.H.1215wx and N.E.S.1002 in the early-maturing group.

Hybrid N.E.H.1202 did best of the experimental early-maturing hybrids tested.

Four very early-maturing experimental hybrids were compared in inland irrigation areas with D.S.28. The yield average of one, N.E.H.1298, in three trials was 1.9 bushels less than D.S.28, but the two weeks earlier maturity of this experimental hybrid drew grower attention.

Extension Activities

Extension activities concentrated on getting the best from the commercially available hybrids. For high yields, the importance of plant population, adequate fertilizer and efficient irrigation was demonstrated.

Coastal growers were encouraged to use higher quantities of fertilizer, through the fertilizer subsidy and the Government's Feed Year Assistance Scheme. In consequence, District agronomists in some coastal areas were able to forecast record yield-averages.

A grower at Mudgee, in a planned attempt for a yield-record, averaged 228 bushels per acre from a 3-acre block of D.S.65A. He used 25,000 plants per acre and 250 units of nitrogen.

The difficulty of making a general fertilizer-use recommendation became obvious from trial results and observations. There were high yields with and without application of nitrogen.

In co-operative trials with a fertilizer company in the southern irrigation areas, a 22 bushel per acre increase in yield was obtained after an initial dressing of 50 units of nitrogen and thereafter, up to the maximum of 200 lb applied, there was an increase of 4.1 bushels per acre for each 25 units of nitrogen used.

An increase of 49 bushels per acre was obtained by application of 100 lb of anhydrous ammonia and this yield increase did not appear to greatly vary irrespective of whether the fertilizer was applied six weeks or one week prior to planting.

The standing-ability of maize hybrids received more emphasis because of increase in mechanical harvesting. There were complaints of lodging of the main coastal-hybrid G.H. 128 and some indications that this was due to increased use of nitrogen and higher plant-densities.

Inbred and single-cross breeding-material was tested on the Comboyne Plateau for resistance to stalk and cob rots, as an aid to the breeding programme.

Plant-populations and row-spacing investigations provided no significant yield-results. There was a tendency to adopt the Department's recommendations for 36 inch to 42 inch row-spacing, with plant populations up to 20,000 per acre.

Use of atrazine on large inland-maize areas became more general. Rates of 2-3 lb per acre gave satisfactory grass and weed control there. But in coastal areas the use of herbicides for weed control was not general.

Hybrid Maize Seed-Certification

Hybrid maize seed-certification details were as follows:

Hybrid	No. Growers	Area Acres	Production Bushels	Yield Avg. Bus./Acre
Early	7	47	1,964	41.8
Midseason	10	39	2,083	53.4
Late	32	397	12,568	31.7
Totals	40	483	16,615	34.4

The total of registered areas was 64 acres greater than in the previous season, and the yield of seed certified (16,615 bus.) was 2,451 bushels greater.

The hybrids G.H. 128 and G.M. 211 developed at Grafton Research Station maintained popularity on the coast and occupied most of the area sown. Hybrid G.H. 128 comprised 68 per cent of the total seed certified. Hybrid N.E.H. 1151, the latest released from Glen Innes Agricultural Research Station, performed pleasingly in inland areas and the acreage sown to it doubled.

There was little carryover seed, and the demand for G.H. 128 and G.M. 211 did not decline—particularly from Queensland growers.

The Hybrid Maize Seed Co-operative continued to function. It allocated foundation-seed to grower-members, but marketing and price were arranged by individual growers.

SWEET CORN

Acreage and Production

Little over 2,000 acres of sweet corn was sown. This was under contract to canners, and in the Tumut, Windsor, Bathurst, and Moree districts.

Hybrid seed for sowing was in short supply. Some low-quality seed was used, with consequent poor germination in some early plantings.

Iochief occupied most of the area for canning and in general the yields were better than for several seasons past. Yield-averages ranged between four and six tons per acre in most districts. One crop reported was nine tons per acre.

Sweet Corn Improvement Programme

Private seed-companies were encouraged to improve sweet corn hybrids and two hybrids tested, NK195 and NK199, gave promising results.

Component inbred-material of hybrids Iochief and Golden Cross Bantam were maintained at Glen Innes Research Station. Selection work to eliminate leaf-blotching of the inbred I5125 continued.

Super-sweet lines of Iochief and Golden Cross Bantam were investigated. Their susceptibility to cob- and grain-rots made handling difficult and the material of doubtful value.

Inbreds from Tennessee were maintained and small quantities of seed of experimental hybrids were produced.

Backcrossing was continued with the Eckhardt isolates of inbreds I5125, I453, P39, P51, R853, R839, and R851.

Sweet Corn Seed Certification

Fifty acres were registered for production of sweet corn certified-seed, and 47 acres were Iochief. Production of certified-seed was estimated at 1,000 x 50 lb sacks of Iochief and 150 x 50 lb sacks of Golden Cross Bantam.

POPCORN

Acreage and Production

Production of commercial-crop popcorn was confined to contract-growing for commercial firms. The area totalled about 600 acres, and was mainly in the Mudgee, Tamworth, Armidale, and Glen Innes districts. At Mudgee a 8½ acre area grown under contact yielded 834 bushels, a yield-average of 98 bushels per acre—the highest so far recorded.

Popcorn Improvement

The Eckhardt isolates of inbreds SAA1-6, SA1490-3, SG18, and 40,000 were advanced a further backcross generation, and selections were made to improve stalk-strength.

GRAIN SORGHUM

Acreage and Production

For the third successive year a dry summer made grain sorghum production difficult. The sown area was estimated at 70,000 acres, most of it in the northwest, and only about 35,000 acres was harvested. Total grain-production was estimated at 1,100,000 bushels; most of it grown under irrigation.

Some crops, with good soil and irrigation, yielded three tons per acre, but the yield-average of many was about two tons.

The dry season induced charcoal rot. Lodging was noticeable in some crops. Aphis and army worms caused some damage. Losses from the midge insect were negligible.

There was a trend towards row-cropping, with furrow irrigation, and there was increased use of nitrogen and atrazine on crops sown in this way.

Purchasers of sorghum grain appeared more conscious of grain quality. Grain protein appeared to again vary by 4-5 per cent.

Hybrid seed representing DeKalb, Northrup King, and Texas material was readily available. Almost all sorghum for grain-purposes in New South Wales was sown with these hybrids.

About 1,000 acres of waxy sorghum (Combine Kafir Waxy) were sown, under contract to Wheat Industries Aust. Ltd, mostly in the Berrigan-Finley area, and the grain was processed at the company's Tamworth factory.

Grain Sorghum Trials

Trials with sorghum hybrids were arranged in 16 growing-centres and 15 hybrids developed from Texas, Northrup King, DeKalb, and Pioneer breeding-material were tested. These were Tx610, Brolga, Tx608, Tx671, Tx626, NK212, NK310, Pioneer 846, Pioneer PX4, Pioneer PX0, C45, F64, E57, C44, E56.

Grain size, grain colour, maturity and disease resistance were stressed more this year, in assessing the value of hybrids. Texas hybrids maintained popularity and continued to show high-yielding characteristics. NK212, E57, C44 and Tx671 appeared best of the new hybrids tested. The maturity of NK310, F64 and Pioneer material appeared to be late.

The seeding rate was again a critical factor in production. Crop failures under dryland conditions were caused by too heavy seeding-rates. Trials under irrigation conditions revealed no significant yield-difference between use of 12 and 8 lb of seed per acre.

The Department did not undertake development of sorghum hybrids but co-operated fully with the Queensland Departmental Breeders in testing experimental material.

Grain Sorghum Seed Certification

Production of certified seed was not undertaken by the Department. Seed production by the Queensland Hybrid Seed Growers' Association and three private seed firms in New South Wales amply catered for growers' needs.

FORAGE SORGHUMS

Acreage and Production

Hybrid forage-sorghums comprised the bulk of the summer forage crops sown. They were widely sown and, in general, superseded sudan grasses and sweet sorghums for forage and fodder.

Hybrids available were Sudax (DeKalb Seed Company), Sordan and Trudan (Northrup King), Zulu (Queensland Department), Calala (New South Wales Department), and Suhy 5 (Pacific Seeds Aust.). Sudax was the most popular, but with little difference in acreage between Sudax, Zulu, Calala and Sordan. Under coastal conditions the hybrids Trudan and Suhy 5 appeared to be more susceptible to leaf blight.

Trials

Grazing and silage trials with hybrids were conducted at 16 centres. Where sown early the better recovery power of hybrids enabled them to outyield sudan grasses and sweet sorghums, and there were yields of up to 30,000 lb of dry matter per acre under the best irrigation-conditions. Where sown late and not grazed, the advantage of the sorghum hybrids over sweet sorghums was not so marked.

At Narrabri Research Station, trials showed that rapid decline of protein content of sorghum hybrids following the first grazing.

Growth-curve studies were continued in most regions, to ascertain the role of forage-sorghum hybrids in feed-year plans.

Addition of nitrogen improved the quantity and quality of sorghum. Fertilizer was used to a greater extent on irrigated crops.

Sorghum Seed Certification

Male-sterile lines for sorghum breeding were maintained at the Tamworth Research Station, but breeding was not undertaken and no hybrid-sorghum seed was certified.

Certification of sudan grass was confined to an area of 50 acres of the variety Piper.

Certification of sweet sorghum was reduced to 113 acres, comprising 11 acres of Tracy, 70 acres of Early Orange, and 32 acres of Saccaline.

MILLETS

Broom Millet Acreage and Production

Production of broom-millet fibre was estimated at 810 short tons from 1,950 acres, an increase of 228 tons over the previous season. Tumut, Gundagai, and the Richmond and Hunter River districts were again the main producing centres. There were 70 acres, under irrigation, in Barham district. Conditions were satisfactory in all districts and above-average yields of good-quality fibre were obtained. Prices ranged from \$410-\$440 per ton.

The improved White Italian strain was fairly widely grown in most growing districts and this had its effect on fibre quality.

Broom Millet Seed Certification

An area of 1½ acres of the Department's White Italian strain was registered for certification, but seed-production was upset by flooding.

Fodder and Grain Millets Production

Dry seasonal conditions reduced production of fodder and grain millets.

For forage, Japanese millet was most popular and was superior for early grazing, though, under summer growing-conditions, Siberian and pearl millets were significantly better in some cases.

A new pearl-cultivar Tamworth was registered for release and seed-increased. Seed production of cultivars Katherine and PC 10 was attempted by private seed firms.

Three pearl millets were tested. Under hot growing-conditions pearl cultivars proved superior, over an extended season.

RICE

Production Records

For the sixth successive season the harvest yielded record production: 210,939 tons of paddy, from 73,820 acres, as against 178,873 tons from 64,154 acres in 1965-66. Two other records were established in the 1967 harvest. The yield-average for the entire rice crop in N.S.W. was 2.86 tons per acre, as against previous records of 2.79 in 1966 and 2.64 in 1959; and the highest yield for a single, entire crop was a record 4.49 tons per acre.

Returns to growers from the 1967 harvest approximated \$12,000,000. After processing, some 80 per cent of the product will be exported. Existing-market needs will again exceed the supply although a record quantity is available for export.

Seasonal conditions were most favourable during pollination and grain-finishing. Other contributors towards the world-record yield-average included management, increased use of nitrogen and availability of highly-selected varietal-strains.

The Rice Industry continued its financial support of the Department's research and extension programmes, and the long-established close contact of industry representatives with the Departmental officers in the rice investigations committee has helped the rapid acceptance of research results.

Industry contributions enabled the rice research programme to maintain more than 60 projects and trials. One of the trial sites produced a record "experimental" yield of 7.25 tons per acre, by far the highest ever reported in literature.

Rice Variety Trends

For the first time since rice industry became established here, the long-standing Caloro was exceeded in production-total although only slightly. Calrose totalled 101,833 tons (av. 2.91 per acre) compared with 101,528 tons of Caloro (av. 2.88). This development was due to the marked yield-improvement of Calrose through the Department's intensive selection programme.

The new long-grained Kulu was grown to the limit of seed-availability and yielded 2,885 tons of paddy, with district crop-averages ranging from 2.5 to 3.0 tons per acre. Because of Kulu seed-shortage, Bluebonnet 50 continued to be grown and produced 4,580 tons of paddy for a yield-average of 1.6 per acre.

Aerial-Sowing of Rice

Following successful research into associated problems, near to 19,000 acres were aerially sown, as against 2,000 in 1965-66. The method has succeeded on salt-affected land, heavy poorly-drained soils, and the poorly-structured "plain" soils. Problems of increased lodging and sterility preclude use of it on soils with irrigated-pasture history.

Anhydrous Ammonia as Nitrogen Source

Some 6,300 acres in the Murrumbidgee Irrigation Areas were fertilized with anhydrous ammonia in this second year of its usage on commercial scale. Previous work had established that it is at least as efficient as the long-used sulphate of ammonia.

Rice Breeding and Improvement

Highlight of the programme was the release and naming of Kulu, the first release from a rice cross-breeding programme in New South Wales. Kulu, known earlier as the cross-bred YRL 1, has so consistently out-performed YRL 2 that YRL 2 has been withdrawn from testing. Kulu yields under commercial conditions were very high for a long-grained variety and far superior to the interim-grown Bluebonnet 50 from U.S.A. Further work will improve Kulu's yield and quality.

Advances were made also in the project to improve quality, yield and hardness of short-grained varieties. Four lines are sufficiently promising to warrant field-testing next season. F₂ material were exposed to a wide range of soil-nitrogen levels, to determine their capacities to respond to variable and high rates of nitrogen. Belle Patna, CI 9434 and Rexoro have been most valuable as parents in the breeding programme.

The new project to develop very short-season varieties has progressed. Sources of earliness are the varieties Hungarian No. 1, Somewake and Belle Patna. Ali Combo was used to introduce improved seedling-vigour, and the Taiwan dwarf variety to improve resistance to lodging.

Sterility, particularly in the Murray Valley, received increased attention. Of the cold-tolerant varieties introduced earlier, the more promising were Hirai, Somewake, Fuzisaka 3, Fukuyuki, Razza 77 and Norin 19.

Rice Pure-seed Production

This programme was expanded to include the new variety Kulu. The scheme again operated successfully. Early stages of multiplication are the responsibility of the rice breeder. A pure-seed committee in each district is responsible for later stages. Cleaning and grading of seed were enhanced by the Rice Marketing Board erecting a well-designed, well-equipped shed.

Gypsum-Nitrogen Interaction

In four trials, application of gypsum did not improve seedling-establishment. Where nitrogen was limiting, sulphate of ammonia applications up to 4 cwt per acre gave linear increases in yield.

Rice-Nutrition Research and Soil Testing

Data from two years of 'rates of nitrogen' research comprising 84 trials were subjected to computer analysis. This determined that relationship between predicted nitrogen-requirements based on soil tests and final yields was not satisfactory. Therefore the soil testing service will be continued as a pilot scheme for at least another year, and plans have been made for research into ways to improve the predictability of the technique.

Increase of low-yielding areas of commercial rice with malformed panicles caused concern. Plant analyses indicated possible involvement of deficient or toxic levels of certain trace elements.

Rice-establishment Research

Aerial seeding into undisturbed pasture produced higher yields than aerial seeding on to a prepared seed-bed, despite inferior seedling-establishment on undisturbed pasture. The yield-differences were due to lower percentage of sterility in the crop in undisturbed-pasture ground.

Variety comparisons were made under aerial-sown and sod-sown conditions. Order of yield was as found in normal methods of sowing; Calrose best, followed by Caloro and Kulu.

Seedlings ranging from 60 lb to 140 lb per acre produced non-significant yield differences despite big differences in seedling-establishment.

Forage Legumes

VETCHES

Interest in use of the vetch crop as a supplement to early spring pasture-grazing was maintained throughout the north coast but, in some instances, areas normally sown to vetches were sown to grazing oats.

Growth was not up to expectations, due to the dry winter and spring. The wet autumn again indicated stem and root rots as serious problems.

A large portion of the vetch seed sown was lime-pelleted, and nodulation was not a problem.

Vetch cultivars were studied at Grafton Research Station. Golden tares proved superior.

Commercial seed-production in New South Wales was very limited. Tasmania was again the source of supply.

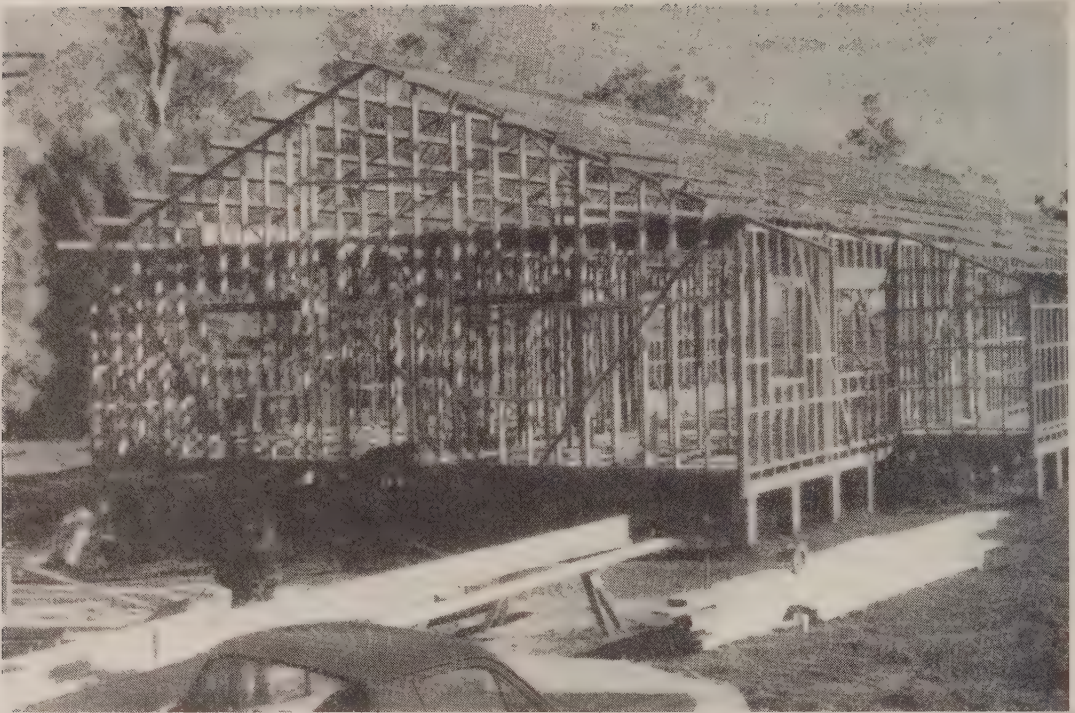
COWPEAS

The cowpea crop maintained its popularity for grazing and grain-production. About 10,000 acres was sown for grain purposes, in the Moree, Gunnedah, Inverell and Coonabarabran districts, but due to the dry summer the grain yield-average was reduced. Total production was about 50,000 bushels.

Poona was the most popular variety. It was excellent on low-fertility soils, and as a rotational crop in wheat-growing districts.

Caloona increased in popularity and three areas were registered for production of certified seed, in Coonabarabran district.

For coastal-grazing, cowpeas were still popular with many farmers but acreage declined. There was complementary increase in popularity of *Dolichos lab lab* due to the latter's greater resistance to root- and stem-rot diseases in wet soil conditions.



For Cotton Research at Narrabri Agricultural Research Station

The Narrabri cotton cross-breeding programme has already been speeded by a heated glasshouse enabling two crops per year. Now the construction of another building (above) for laboratory and allied work-space will facilitate development and long-term storage of valuable breeding-material and nucleus pure seed

Cotton

PRODUCTION TRENDS

Low level of stored water in Keepit Dam held back the rapid-expansion trend of cotton acreage and production.

The record 1965-66 sowing of 33,176 acres in N.S.W. had produced 69,695 bales of raw cotton but the 1966-67 area was estimated as only 30,400 acres and production was about 52,500 bales.

In the Namoi Valley 27,500 acres were planted, compared with 31,245 acres in the preceding year, 12 per cent less. Much of this acreage was sown late, after useful spring rains, but autumn conditions did not favour the "finish" and quality and yield were affected. Namoi Valley production was estimated at 49,100 bales; 1.78 bales per acre.

In southern areas, acreage was reduced because of lack of a well-adapted variety. Yield-average from this area has been estimated to exceed one bale per acre, but individual-farm yields of two bales per acre indicated prospects for increased overall yield-average. Length and quality are satisfactory.

In the Macquarie River Valley, 540 acres were sown. Two-thirds of this acreage produced an average of 1.8 bales per acre after suffering early-season stress. Greatly expanded acreage in the 1967-68 season is expected. For the first time a small area of cotton was grown commercially at Bourke. It yielded two bales per acre.

COMMONWEALTH BOUNTY ON COTTON

The Raw Cotton Bounty Act of 1963 applies a bounty to raw cotton produced and used in Australia. This year it returned bounty payments at an average rate similar to that which applied to the 1965-66 crop; 8.5 cents per lb. The "basic" rate, 13.4375 cents per lb of raw cotton (for "middling 1-inch white"), is varied according to grade by a scale of premiums and discounts and the average rate declines with increasing Australian production beyond about 60,000 bales per annum. The 1967-68 crop will be the last to receive benefits from the current bounty term.

COTTON FIBRE RESEARCH LABORATORY DELAYED

Development of this Laboratory has not taken place as planned, due to changes and delays in the proposed building programme at Rydalmere.

Co-operation from the University of New South Wales and Bradford Cotton Ltd permitted a limited programme of testing.

Until the projected Laboratory is completed the research programme, and the staff that can be employed, will be limited to what is possible in the currently available air-conditioned space.

COTTON QUARANTINE, BREEDING, AND IMPROVEMENT

This Department's Cotton Plant Breeder was absent, at the year's Plant Breeding Genetics course conducted by the CSIRO at Canberra. Even so, the breeding and improvement programme was continued by carefully-planned visits to Narrabri Agricultural Research Station and the co-operation of other cotton agronomists.

The Stage I replicated testing and the selfing-programme were continued in the field. Provision of a cotton pure-seed production-cage, to prevent cross-pollination, will permit in future a simplified selfing programme.

The cross-breeding programme has been accelerated by production of two crops per annum in a heated glasshouse at Narrabri Agricultural Research Station. Eighty-three crosses were made this year.

Progeny-testing and Verticillium Wilt-testing continued, and selections were made.

This was a record year at the cotton-quarantine glasshouse at Glen Innes. Some 70 introductions from the U.S.A., U.S.S.R., Greece, and Africa were passed through quarantine. Single-plant selections were made within this material by the breeder. A further 10 "wild" species of cotton were quarantined at Canberra.

Many of the introductions from the U.S.A. were derived from an environment rather like that of southwestern New South Wales, and a lot of these have been passed over to the CSIRO cotton breeder at Griffith.

A new building for cotton breeding was commenced at Narrabri Agricultural Research Station. This includes offices, laboratory work-space and seed stores. One of the seed stores is a constant-humidity and temperature storage-room for long-term storage of valuable breeding and nucleus pure-seed cotton.

COTTON VARIETIES

Trends. Deltapine Smoothleaf maintained its dominance in the Namoi area. A few hundred acres of Stoneville 7-02 were also grown there commercially. In the southwest, both Deltapine Smoothleaf and Empire 289 were grown but the latter will replace Deltapine Smoothleaf pending availability of varieties better adapted to the environment.

Testings. Stage II and Stage III variety testing were carried out at three sites in the Namoi area, including Narrabri Agricultural Research Station. In the southwest, the variety testing was done in co-operation with Griffith staff of the CSIRO.

In Stage III trials in Namoi area, Deltapine Smoothleaf was highest yielding. Stoneville 7-02 also did well. In Stage II tests, Deltapine Smoothleaf strains and Stoneville 7-04 and 7-02 did well.

Gregg 121, included in only one trial, produced the highest yield; 1,520 lb at an average exceeding three bales per acre. Carolina Queen repeated its very good 1965-66 performance in one Stage II trial.

The Department's Narrabri Agricultural Research Station and the CSIRO co-operated to conduct a National Variety Trial, wherein selected varieties are grown at sites in New South Wales, Queensland, and Northern Australia. Variations in behaviour of these varieties were recorded as means of studying physiological changes induced by environment.

In the southwestern districts, two of the variety-trial sites contained varieties for spindle-picking whilst the other two sites grew varieties suitable to stripper-harvesting. Of the spindle-picked varieties: Russian, Paymaster, and Empire 289 had the highest yield-averages, 1.75 bales per acre, and Russian was much earlier maturing than Empire 289. Another variety notable for early maturity was CA 491. In the stripper-varieties: CA 491 was again noted for early maturity, whilst it and CA 398 and Empire 289 were the highest yield-average varieties at from 1.36 to 1.23 bales per acre.

COTTON PURE-SEED SUPPLIES

Cross-pollination between cotton plants is possible, and in fact readily occurs in the presence of some insects. Maintenance of purity in promising new lines and in older varieties is managed by "selfing", either by bagging flowers or by growing the plants in an insect-proofed cage. Using these methods, small quantities of pure seed of the essential in-use or potentially-useful varieties are supplied annually. Stoneville 7-02 was initially-increased by these means and, after field-increase in isolation from other cotton, was extended to limited commercial production.

Cotton Seed Distributors Ltd at Wee Waa (previously the Namoi Cotton Seed Association) and the Cotton Pure Seed Committee in the southwest continued to be important in the production and supply of seed to growers. Cotton Seed Distributors Ltd has established an acid-delinting and seed-preparation plant and supplied and/or treated seed for the Cotton Marketing Board of Queensland as well as for growers throughout New South Wales.

COTTON-PRODUCTION RESEARCH

Namoi Area. The main emphasis in this region was again on nitrogen investigations.

The number of nitrogen trials conducted on cotton properties was restricted by the water-supply situation of the Namoi River. Four trials were conducted, using six rates of nitrogen up to 200 lb per acre. Responses to nitrogen were smaller than in the previous season; probably reflecting seasonal conditions, including water supply. Soil samples were obtained prior to sowing and petiole-samplings were regular throughout the growing season.

Relationships between nitrogen applications, irrigation intensities, varieties and the petiole-nitrate levels were also investigated in trials.

Because of analytical work in the 1965-66 season the relationships of nitrogen, phosphorus, zinc, and manganese in cotton were investigated in 1966-67. No conclusions were possible by observation, so the outcome depends on the results of biometrical analysis.

The "go-devil" type of disc implement was best of the various implements tested to determine the most effective machine for incorporation of herbicides.

In a pre-emergent herbicide trial, fluometuron, trifluralin, and prometryne were the most successful—dependent on the seed-range.

Southwestern Areas. Investigations into rate and date of sowing showed the importance of early-sowing and of high sowing-rate in influencing the yields of currently-used cotton varieties.

A trial investigating tillage-methods, use of gypsum at rates up to 5,000 lb per acre, and timing of the last irrigation, showed that in 1966-67 conditions the early-March water cut-off and the high rate of gypsum produced best yields.

Interaction of gypsum, nitrogen, and phosphorus was incorporated in a trial at Yanco Agricultural College and Research Stations. Yield-increase from the 5,000 lb rate of gypsum was significant but there was no response from the other fertilizers.

Herbicide investigations at Yanco showed the effectiveness of a trifluralin/prometryne mixture, and of fluometuron and norea.

Adverse effects observed with combinations of systemic insecticides and herbicides were investigated.

The rotary hoe was the most efficient of the range of implements used to incorporate herbicides.

Tobacco

ACREAGE, YIELD, AND QUALITY TRENDS

The northern New South Wales tobacco industry, providing virtually the whole of the New South Wales acreage, reversed the downward acreage-trend of the preceding two seasons. Plantings had fallen from 2,835 acres in 1963-64 to 1,618 by 1965-66, but rose by 9 per cent to 1,765 acres in 1966-67. The recovery was greatest along the Dumaresq River and a result of increased farm-areas rather than increased numbers of growers.

Many farmers averaged 1,500 lb leaf per acre, and some higher, and the State yield-average is estimated at almost 1,200 lb per acre. The New South Wales total was about 2,100,000 lb of cured leaf, and quality overall was better than in the previous season.

TOBACCO MARKETING

The organized tobacco marketing system operating through the Australian Tobacco Board and State Boards in the three producing States continued to function satisfactorily. Price averages for New South Wales leaf at the Brisbane Tobacco Sales were satisfactory.

Overseas Visit by Tobacco Research Agronomist

Tobacco Research Agronomist Mr A. D. Doyle attended the 4th International Tobacco Science Congress, held at Athens in September, 1966, and presented a paper—"Investigations into Fertilizer Requirements of Flue-Cured Tobacco on Granite Soils in Northern New South Wales".

En route to the Congress he spent five weeks visiting tobacco research stations in Canada and the U.S.A., mainly with reference to sucker control and the use of herbicides.

Tobacco Research

Sucker Control and Herbicides. Tobacco research in the Ashford area in 1966-67 closely examined the use of sucker control materials and herbicides. Four sucker control trials gave evidence of the effectiveness of penar.

In weed control trials, including seven pre-planting experiments, the herbicide benefin exerted good weed control. In one trial, tillam showed definite promise for nut-grass control.

Variety Trials. Two trials compared selected strains of Hicks and two selections of NC 73. There was also a blue-mould resistance trial, a mosaic resistance trial, and a segregating observation block. All were conducted from Glen Innes Agricultural Research Station. The trials were severely affected by hail but, where practicable, selections were made and data were recorded.

Oil Crops

LINSEED

Acreage and Production

The 1966-67 linseed acreage was approximately four times that of the drought affected 1965-66 season. The total was estimated as in excess of 8,000 acres, producing almost 3,000 tons and a satisfactory yield-average of about 14 bushels per acre.

Limited Linseed Research

Work concerned with this crop was limited mainly to the introduction, quarantining, and testing of varieties.

Twelve new varieties, from the U.S.A., and Argentina, progressed to preliminary stages of testing. Some 30 selected varieties from the world collection were tested for yield and disease reactions, and 32 varieties were seed-increased in preparation for variety testing.

In seeding-rate and zinc-nutrition trials at Narrabri Agricultural Research Station, under irrigation, the best yields exceeded 30 bushels per acre and yields were highest from the higher rates of zinc sulphate applied at sowing.

SAFFLOWER

Acreage and Production Increased

Before 1966-67, the safflower acreage in New South Wales over a 12-year period had ranged from 8 to 2,539 acres per year and exceeded 1,000 acres in only three seasons. Over that period of 12 years, the yield-average was 9.5 bushels per acre. In 1966-67 the area was almost 6,000 acres, and 5,500 were in the northwest. Yield-average was estimated at 560 lb per acre; slightly less than 14 bushels. The best yield recorded for a commercial crop was 1,900 lb per acre.

Safflower Research

Field trials continued to examine seeding rates and fertilizers, under irrigation, and the time of last irrigation.

Variety testing was also done under dryland conditions. Gila and Horowitz yielded significantly higher than other varieties in the dryland variety testing.

Three introduced lines of safflower were passed through quarantine in readiness for evaluation under N.S.W. conditions.

SUNFLOWER

Acreage and Production

The 2,500 acres of sunflowers grown in 1966-67 comprised a record area. The estimated yield-average was 560 lb per acre. Yields were affected by adverse seasonal conditions, by Rutherglen bug injury to northwestern dryland crops, and by inadequate fertilizer applications and irrigation management in the southwest.

Sunflower Research

Variety-testing was done under irrigation at three centres. Nine lines with superior oil-yield character were compared to the standard Polestar variety. Results varied as between sites and as between fertilizer rates and seeding rates.

At the Yanco Research Station, where varieties responded significantly to 1½ cwt of sulphate of ammonia per acre, five varieties gave yields superior to the remainder.

Yields were highest at Narrabri Research Station. Approximate ½ ton per acre yields were produced by: Bulgarian C 1957, P 6126; Peredovik P 5605 and P. 6296; VN II MK 5540, P. 6294; and Stepriah P. 5448.

Sunflower Seed Production

To expand the sunflower research it was necessary to produce pure seed of eight varieties, hybrid seed as a parent for one variety, and seed of two hybrids. This crop is a cross-pollinator so the seed production work had to be done in isolation.

SOYBEANS

Production Trends, and Consumption

Some 26,000 tons of soybean meal and 4,000 tons of soybean oil were imported into Australia in 1965-66. Production of soybean meal at the 1965-66 importation rate would require 33,500 tons of locally grown soybeans and these would give a surplus of soybean oil for export. That rate of production would imply 50,000 acres of soybeans and a yield-average of 25 bushels per acre.

Soybean production in Australia has never been significant but in 1966-67 the acreage fell (compared to the 1964-65 peak of 5,000 acres) to an estimated 1,250 acres. Of the 1,250 acres, only 250 acres were grown in New South Wales. Most of the seed produced will be retained for 1967-68 sowings, when expansion of acreage is expected to result from overseas importers' keen interest in the possibility of N.S.W. production for export.

Soybean Research

Detailed trials in recent years have been aimed to reveal areas to which photoperiodic soybean-groups, and the varieties within these groups, are adapted. The trials aim also to ascertain the most suitable time of sowing. The work proceeded at Leeton, Narrabri, and Glen Innes Agricultural Research Stations in 1966-67. Results so far suggest that varieties from three particular groups may be best suited to N.S.W. conditions.

Detailed trials were conducted also on farmers' properties, in the southwest and the northwest.

Preliminary testing of 23, F6 crossbred lines for yield and sowing time was also commenced at Glen Innes Agricultural Research Station.

Soybean Seed Production

Seed production of 51 lines of soybeans was arranged in 1966-67 at five Research Stations, to provide seed for an expanded programme of tests in 1967-68. For reasons not yet known, 25 varieties sown at Leeton Agricultural Research Station failed to set seed.

Some Miscellaneous Other Crops

Rapeseed

Variety testing was started in 1966-67 at two sites. Five varieties introduced for oilseed-production were compared with the commercially-available varieties.

Seed-production of these and two other introduced varieties was also launched, to prepare for further testing.

Castor Bean

Castor bean varieties were tested again at Leeton Agricultural Research Station. Ten varieties were sown in a replicated trial.

Eight lines were seed-increased in isolation at six Research Stations to prepare for further testing in 1967-68.

Sesame

Pure-seed production continued. Five varieties were grown at three Research Stations. The recently-produced seed will provide the nucleus for increase of good-quality seed, for further variety-testing.

Canary Seed

The last recorded production was 1,139 acres in 1963-64. In 1966-67 a recent introduction was seed-increased in preparation for variety-testing.

Peanuts

The peanut acreage in Australia has steadily increased in recent years, to 58,000 in 1965-66 and an estimated 69,000 acres in 1966-67. The acreage in N.S.W. has changed little, 394 acres in 1965-66 and a similar total in 1966-67. New South Wales production in 1966-67 is estimated as 220 tons, negligible in the Australian total of 36,000 tons.

Vegetables

Some Notable Production Trends

Larger-Scale Production. A trend to larger-scale production of vegetables is obvious. It is due mainly to two influences: firstly, the supermarkets, demanding large quantities of uniform produce rather than many small lines which can vary in quality and make pricing and pre-packaging difficult; secondly, more mechanized methods, to reduce unit costs and permit a profit margin in a highly competitive field.

The trend towards larger acreages is typified in the Murrumbidgee Irrigation Area where, in the past two years acreage has increased by 25 per cent without noticeable increase in number of growers.

Greater Out-of-season Production. Trends in the pattern of production of winter beans and tomatoes show that a greater volume of these vegetables is being produced on the far north coast, coming in at the same time as Queensland-grown crops. Competition from Queensland and north coast crops has severely affected the glasshouse industry at Mona Vale and the early-bean growers in Gosford district. The early bag-covered tomato crop from west of Liverpool has also been affected and the tendency there now is to plant later with smooth-skinned varieties rather than a July planting of the crinkly-fruited Rouge de Marmande.

Trends in Market Gardening. Following the housewives' adoption of supermarket buying, pre-packaged root vegetables have largely superseded bunched vegetables traditionally grown in Metropolitan market gardens. Loss of market garden areas in such districts as Mascot, Milperra, Caringbah, St Ives and Ryde-Eastwood, to housing and industry, has therefore not created a supply problem. Other vegetables, required in a fresh state, such as lettuce, silver beet, parsley, mint and cabbages, are usually sold in the Growers Market. With loss of the aforementioned districts, to housing and industry, market gardening has extended west of Liverpool and in the Hills district and in the vicinity of Quakers Hill and Schofields.

Onion Growing Boom. A vast increase in onion acreage was noted in the 1966-67 season. This was prompted by the previous year's good prices, export prospects, and the impression that the normally severe weed problem could be overcome by selective herbicides. Much of the increased acreage was in the Murrumbidgee Irrigation Area, but sowings were big elsewhere.

The venture had mixed results. Inexperienced growers found difficulty with excessive weed-growth in spite of herbicides. Early varieties were overproduced and met poor prices. Where harvest was delayed, in hope of better prices, losses through soft rot and sunscald were severe. Later maturing crops were more successful, and a proportion was exported.

POTATOES

Naming of New Variety: "Jala"

The seedling S2881, a selection from Awaba x 336-123, continued to perform well in South Australia and at the request of the S.A. Department of Agriculture was named "Jala", an aboriginal word meaning slow. It has mid-season maturity and produces high yields of round white shallow-eyed tubers with excellent cooking quality. Jala has moderate resistance to common scab, and field-resistance to early and late blights.

Breeding

The main potato breeding programme continued at Glen Innes Agricultural Research Station. Substantial advances were made.

In the crossing programme, 309 successful crosses yielded 750 berries and about 40,000 seeds. The range of parents included those which had given promising progeny in previous years, newer varieties not as yet fully tested, and a good range of locally-developed seedlings and varieties. The previously-proven good parents included the U.S.D.A. varieties Avon, Blanca, Fundy, Navajo and Kennebec. These with new varieties, including Arenac, Emmet, Shoshoni, Snowflake and Superior, were most commonly used in crosses with the Department's own seedlings.

Approximately 27,500 first-year seedlings were produced, representing progeny from 428 lines. Progenies involving the varieties Blanca, Superior, Navajo and S2898 were outstanding, and a further line (F4724 x (Sebago x 11-79)) is particularly promising.

In the second-year generation, 340 progenies, represented by 4,000 seedlings, were planted at the substation and 460 single-plant selections were made. Best selections were from a number of lines with Blanca as the female parent, and from the crosses Superior x S2898 and Kurrel x S2898.

A total of 530 third-year seedlings was grown, and 120 promising lines were selected. The best was a selection from the cross (Kurrel x S2898). Lines from crosses involving S2898 as a male parent were particularly good. Other parents producing good progeny included Fundy, Adina, Exton and S2856.

148 fourth-year seedlings were grown at Red Range, and 66 were selected to advance to preliminary yield trials. The best lines selected were (11-79 x Cherokee) x Crana, two lines from Blanca x Katahdin and two from Navajo x Katahdin. One holds special interest because of high specific gravity, 1.104.

The preliminary yield trial was also grown at Red Range, and seven promising lines were selected to advance further. Of these (S2776 x Katahdin) x S2782 and B595-76 x Katahdin stood out in appearance, yield and specific gravity, 1.096 and 1.092 respectively.

Potato Breeding for Disease Resistance

Common Scab (*Streptomyces scabies*). About 2,000 first-year seedlings were tested for resistance in the glasshouse at Glen Innes. Resistance was in the main derived from the U.S.A. varieties Cherokee, Redskin, Ona and G595-76 and the Canadian breeding-line F4724.

Scab-reactions of a number of seedlings and varieties were assessed at the Orange Research Station. The newly introduced variety Shoshoni showed the highest level of resistance. Local seedlings S2897 (Redskin nat. pollination) and S2919 (B595-76 x Katahdin) also were significantly more resistant than Exton, the susceptible check variety.

Late Blight (*Phytophthora infestans*). Twenty-two advanced seedlings were tested for resistance, using the "detached leaf" method. Six were immune to late blight. The most advanced of these is S2901, a selection from S2864 x Merrimack.

Advanced Seedlings' Yield-Trials

These trials were conducted on the northern tablelands at Guyra, and on the central tablelands at Orange Research Station.

From the extensive Guyra trial 27 seedlings were selected for further testing in replicated trials. Best of the early-maturing were S2929, a selection from B595-76 x Adina, S2946 (Onaway x Adina) and S2893 (66-10 x 11-79). Best of the late-maturing were Kurrel and S2920 (Pungo x 1928(e)2 x Cherokee).

At Orange Research Station, 41 advanced seedlings were compared with commercial varieties in replicated trials. In the early-trial, the scab resistant S2897 was again outstanding except for very slight tendency to internal fleck. S2893, S2894, S2917 and S2925 also did well. Of those in the late-maturing section of the trial, the seedling S2902 (Delux x Redskin) was the most outstanding and S2881, S2885, and Kurrel also did well.

Advanced seedlings and varieties were again supplied to research workers in other States. Of those supplied to South Australia, the seedling S2881 (from the cross Awaba x 336-123) continued so successful that it was named "Jala" and released for commercial use there.

Potato Introductions

A number of new and recent introductions were grown at Orange Research Station. Of the older introductions, the red-skinned Excel is very promising. It gives a good yield of attractive red-skinned tubers with excellent cooking quality. Of the more recent introductions, Arenac and Emmet from the U.S.A. give excellent results.

Potato Fertilizer Trial

Further series of trials to determine optimum rates of nitrogen, phosphorus and potash were conducted in potato districts.

In a Robertson trial 2 cwt of sulphate of ammonia increased the yield of No. 1 Grade by about 50 per cent; 4 cwt by a further 17 per cent, and 6 cwt by a further 20 per cent. Four cwt of sulphate of potash gave very significant yield-increase over the nil application. The proportion of No. 1 Grade was also significantly increased by addition of both nitrogen and potash. At Crookwell, sulphate of ammonia gave a linear response up to 3 cwt. Without potash, superphosphate gave no significant response above 4 cwt, but in the presence of 4 cwt sulphate of potash a significant response to 12 cwt superphosphate was obtained. At Blayney, on the other hand, superphosphate continued to give significant responses up to 12 cwt but potash at 6 cwt significantly reduced yields.

Potato Quality Tests

Cooking tests were done by the CSIRO Division of Food Preservation tasting-panel, on a number of advanced seedlings. The standard, Kennebec, had the highest quality, followed by S2893 and S2881 (Jala).

Specific-gravity determinations were carried out on all advanced seedlings at Glen Innes and all seedlings and varieties at Orange Research Station. At Glen Innes, many seedlings gave a reading in excess of 1.095. Some of these were extremely high, such as 1.103 (Saranac x 11-79) x S2782, 1.104 for Navajo x Katahdin and 1.101 for Navajo x (11-79 x Cherokee). The seedling S2893 again gave a high reading, 1.102. At Orange Research Station, the general level of readings was slightly lower. Highest readings came from Murru (1.097), S2893 (1.095), S2894 (1.095) and Emmet (1.094).

To determine suitability for crisping the full range of seedlings produced at Orange Research Station were tested. The standard, Kennebec, produced crisps of excellent colour and texture even up to two months after harvest. Sebago also gave crisps of acceptable colour but, because of the lower specific gravity, had a higher uptake of oil. Other varieties to crisp well were Superior, La Chipper and Pennchip from the U.S.A. and Bintje from Holland. Best of the locally-developed seedlings were S2893, S2894, S2901 and S2948. The seedlings S2893 and S2901 seemed very promising for crisping.

Potato Elite-Seed Production

The programme of elite-seed selection and production continued and was expanded at Orange Research Station. Yields were excellent. Seed-stock has been so built up that about four tons of elite seed of each of the major varieties have been made available for distribution to certified-seed growers in the coming season.

Small selected samples of elite seed of Sebago, Sequoia, Bungama, Exton and Kurrel were supplied to some certified seed growers for growing in the current season, in comparison with normal certified seed. Plants from the elite seed had more vigour and freedom from diseases than those from normal, certified seed.

The programme of single plant selections of the commercial varieties was continued, these to be used in the tuber-indexing work. New lines of Sebago, Kennebec and Katahdin recently introduced from U.S.A., have also been brought into the programme. These are being compared with local growers' lines of these varieties, selected over a period of years.

Potato Certified Seed Production

In the Seed Certification Scheme 917 acres were passed for certification, as against 800 in the previous season. The rejection rate was about 5½ per cent, but mainly because of withdrawals rather than rejections, as against 2½ per cent in the previous season.

In the second year of operation of the approved seed scheme, 445 acres were submitted, by 33 growers, and 362 acres passed inspection. The rejection rate was about 19 per cent.

TOMATOES

Breeding

Programmes continued at Hawkesbury Agricultural College and Yanco Agricultural College and Research Station, the former to develop varieties for staking and trellising and the latter to produce types for processing.

At Hawkesbury, besides many lines in early generations, 21 advanced crossbred lines, 27 first generation hybrids and 36 introductions were tested. Two of the most outstanding advanced crossbreds were Anahu x Step 286 and Kokomo x Rouge de Marmande, as in 1965-66. Of the hybrids, three combinations Oahu x Campbell 146, Oahu x Gross Lisse and HES 6586 x Grosse gave excellent results. All three are mid-season in maturity.

At Yanco, a wide range of parents is being used to develop varieties with dwarf habit, *Fusarium*-wilt resistance and high processing quality. Further selections were made both for manual and mechanical harvesting. For the first time an objective method of assessing crack-resistance was applied to 105 varieties and breeding lines. The test comprises the application of vacuum to the fruits immersed in water. It was a valuable aid in assessing varietal merit.

Screening for resistance to *Fusarium*-wilt is regular practice at both places, from the F2 generation onward.

Tomato Variety Trials

A trial of local and introduced varieties was done on a grower's property to assess suitability for mechanical production. Besides agronomic habit, the processing attributes of each variety were assessed in collaboration with the Leeton Co-operative Canneries.

Tomato Introductions

Burnley Bounty, from the Victorian Department of Agriculture performed well as a *Verticillium*-resistant variety at Hawkesbury. At Yanco, many lines showed promise. These included Burnley Surecrop, from the Victorian Department of Agriculture, VFN48A, Chico and Chico Grande from U.S.A., and Kc109 and Campbell No. 17 from Campbells Soups (Aust.) Pty Ltd.

Tomato *Verticillium*-wilt Problem

Increasing evidence of *Verticillium*-wilt infection in commercial crops has caused concern. Resistant strains of Marmande, Valiant, Stokesdale and Firesteel from Canada were compared with local strains, and tests by the Division of Science Services confirmed their resistance to local strains of *Verticillium*. Seed has been made available to the industry, and the Department has recommended the use of VR Marmande and VR Valiant instead of the non-resistant strains as parents in the production of hybrids.

Success of New Tomato Varieties

Yanco Premium and Yanco Juicemaster, named and released in 1965-66, were grown on a substantial scale in the M.I.A. this season, and highly satisfactory.

BEANS

Breeding

Feature of the breeding programme at Hawkesbury Agricultural College was the potential shown by the parent Cornell 49-242, a semi-wild bean native to South Africa. It has multiple disease-resistance. Back-crossing was necessary because of its degenerate type, but a number of lines with Cornell 49-242 in the parenthood are now at advanced-stage and showing outstanding promise.

Anthraxnose-resistance was tested during the winter in the glasshouse, and reaction to rust was assessed in the field.

In the spring and autumn 87 varieties and crossbred-lines were under test. Fixed-crossbreds showing outstanding promise as stringless varieties included (Hawkesbury Wonder x Granda) x Cornell 49-242, Processor x (Hawkesbury Wonder x Granda) x Processor, and (Fullgreen x Brown Beauty) x (Hawkesbury Wonder x Granda). Among the string-bearing types, two selections from the (Hawkesbury Wonder x Granda) x Cornell 49-242 gave excellent results, and a selection from the cross (Hawkesbury Wonder x Granda) x (Fullgreen x Brown Beauty) x (Brown Beauty x Little Navy) also showed promise.

At Yanco, main attention in the breeding programme was aimed towards achieving resistance to the root-rot complex which has caused heavy losses in stringless, processing beans. Further selections were made, in crossbreds in advanced generations. Also, new crosses using parents resistant to the complex were made.

Bean Introduction

Two stringless varieties Idelight and Yakima from the U.S.A. are of good agronomic type and show resistance to the root rot complex. Two other lines, OSU949 and UI. No. 15, have been retained as parents because of outstanding resistance to disease.

Manganese Trial

At Terranora Vegetable Station the trial which showed that a single application of lime progressively countered manganese toxicity was completed in spring 1966.

New research was started at the Tropical Fruit Research Station, Alstonville, in association with the Division of Science Services: on varietal reaction to manganese, on lime and other ameliorants, and the influence of potassium chloride on trouble in beans and other crops.

Bean Seed Certification

Sixty-two acres were submitted for inspection under the French Bean Seed Certification Scheme, as against 55 in 1965-66, and 440 bushels was produced as against 400 in that year.

ROCKMELONS

Further selections were made in the progeny of crosses between commercial varieties and oriental melons used as a source of resistance to powdery mildew and *Fusarium*-wilt. Fourteen selections in advanced-generations were under observation at Yanco Agricultural College and Research Station and Griffith Viticultural Research Station. Three lines selected for disease resistance, yield, and fruit-quality were self-pollinated to produce seed. The seed is to be sown in isolation for seed-increase, with view to release as commercial varieties. Selection to improve fruit-shape and flesh-quality continued in the remaining lines.

Two introductions, Campo and Malo Sterile 2, were imported; the former for its fruit-type and carrying quality combined with mildew-resistance; the latter for its mildew-resistance and potential as a parent for hybrid-rockmelon production.

PEAS

Breeding Processing Varieties

Seven fixed-crossbred lines were tested at Hawkesbury Agricultural College; the produce subjected to quick-freezing and canning tests. Two selections from the cross Early Wonder x Canner 75 and one from Super Alaska x Greenfeast were comparable in yield to the standard processing variety, superior in regard to uniform-maturity and colour, texture and flavour of the processed peas. Several fixed-lines from the College have shown promise in a New Zealand seed firm trial plots.

ASPARAGUS

"Decline"-research, Gundagai

Asparagus research continued at the property of the Gundagai Asparagus Co-operative. In the planning committee the Department, the Rural Bank and the Mountain Maid Food Co-operative are represented.

Useful results are accumulating from a rotation trial. These so far suggest that asparagus can be re-established on old asparagus-land much sooner than was anticipated but pathological examination of crowns from the experiment indicated that inclusion of sweet corn in the rotation encourages early infection with *Fusarium*. Sweet corn is a convenient and profitable crop, but the Co-operative has decided that it would not be grown again on the asparagus farm, since it is a threat to asparagus, the major crop.

Other investigations providing valuable leads include a basic-superphosphate trial, a gypsum-rate trial, and a controlled irrigation trial.

CAPSICUMS

Improvement Work

With increasing demand for capsicums, on the fresh market and for processing, a project to improve fruit type, yield, growth habit, and resistance to mosaic continued at Hawkesbury Agricultural College. Most lines under test are still segregating.

An introduction from Hungary appeared suitable for manufacture of paprika.

VEGETABLE-PROGRAMME AT ALSTONVILLE TROPICAL FRUIT RESEARCH STATION

Beans, Tomatoes, Beetroot, Sweet Potatoes

Progress was made in development of vegetable research here. Installation of irrigation facilities was a substantial undertaking. Bean selection and variety trials as an adjunct to the breeding programme at Hawkesbury College were started in the winter of 1966. Trials with canning varieties of tomatoes and beetroot have been started, for guidance of growers producing for the local cannery. A sweet-potato nursery for maintenance of named varieties has been established.



For Whole-town Control of fruit fly

In many inland towns, fruit fly has been almost 100 per cent suppressed by whole-town adoption of campaign-measures wherein the Local Government Council, house-holders, and the Department of Agriculture are collaborators

DIVISION OF HORTICULTURE

General

STAFF

Administrative Positions

Following the appointing of Mr B. Owen French to the position of Deputy Director-General, Mr R. G. Kebby was promoted to Chief of the Division of Horticulture and Mr G. R. Gregory to the position of Deputy Chief. Mr A. H. Skepper was appointed to the new position of Principal Fruit Officer (Regulatory). On the retirement of Messrs E. C. Levitt and H. J. Cann, Mr D. S. Leigh was promoted to Special Fruit Officer (Tropical Fruits) and Mr J. W. Turpin to Special Fruit Officer (Citrus Fruits). At 30th June, 1967, the Special Fruit Officer (Viticulture) and Assistant Principal Fruit Officer (Extension) positions remained vacant.

Research Positions

Four new fruit research officer positions were established, bringing the research strength to 21 officers. The new positions at Bathurst and Griffith Research Stations were filled.

Those at the Narara and Dareton Research Stations are vacant. Three research officers are on full-time post graduate study leave. One other resumed duties following three years' overseas leave.

Extension Positions

Three young extension officers were recruited but there are still four vacancies in the extension establishment. Moreover, five District fruit officer positions and one research station position are vacant. Retirements early in 1968 will create further vacancies additional to any caused by the establishment increase.

Regulatory Positions

At 30th June, 1967, only one regulatory position was vacant, namely at Broken Hill. New positions at Barham, West Wyalong and Gunnedah became functional and will mean progress in control of fruit fly in areas west of the Dividing Range. Metropolitan inspectorates have been reviewed, towards better co-ordination of the State and Commonwealth duties and of quarantine inspection services at Kingsford Smith Airport. One result is a recommendation for the employment of an additional inspector.

Overseas Visits and Studies

Mr B. Owen French, the then Chief of Division, represented N.S.W. and Australia as a co-delegate to the 17th International Horticultural Congress held in Maryland, U.S.A., in August, 1966. He visited also other parts of the U.S.A., and the West Indies, South Africa, England and Europe to investigate recent trends in research, production and marketing of fruit crops.

Former Principal Fruit Officer (Viticulture) now Deputy Chief of Division, Mr G. R. Gregory, was awarded the Rudi Buring Memorial Scholarship. This is awarded at five-year intervals, to a diplomate of the Oenology Course at Roseworthy College, South Australia. It provided a five months' overseas study tour from July to December, 1966. He visited the U.S.A., Europe and South Africa and concentrated on the wine-, drying- and table-grape industries.

Fruit Officer (Research) Dr W. J. Greenhalgh completed three years' post-graduate studies at the Cornell University, U.S.A., and was awarded the degree of Doctor of Philosophy for research on growth regulators in fruit production. He resumed his research programme at Bathurst Agricultural Research Station in May, 1967.

Senior Inspector Mr R. W. Robertson was granted six months special leave to proceed to the United Kingdom and Europe as Assistant to the Australian Fruit Officer.

Research for the Fruit Industries

RESEARCH—CITRUS INDUSTRIES

Stem-Pit Control in Grapefruit

One of the limiting factors to grapefruit production in Australia has been the "stem-pit" virus. It affects fruit shape, size and production, reduces tree vigour and causes pitting of the trunks and limbs. The Citrus Improvement Committee has for many years investigated "stem-pit".

Preliminary experiments determined the existence of virus strains which varied from mild to severe in symptom expression, and indicated possible commercial protection against severe strains by using budwood carrying mild strains of the virus instead of virus-free budwood.

Field trials were located at the Horticultural Research Stations at Narara and Dareton to test various aspects of protection and cross-infection under normal field conditions, as occurring in the totally different climatic conditions of coastal and semi-arid regions. The plantings include virus-free trees with and without various mild-strain inoculants, severe-strain trees, and mild-strain trees.

Results so far indicate that symptom-expression by the various strains is much more apparent at Somersby than at Dareton where vigour may be temporarily overcoming virus effects. All trials give hope that the mild strains have a protecting effect under normal orchard conditions for a number of years. Field observations of commercial blocks of trees of known origin also support this.

Nutrition of Navel Oranges

A nitrogen fertilizer trial was initiated at Yanco Agricultural College and Research Station in 1953 to compare two levels (0.8 and 1.6 lb of N/tree) and two sources (sulphate of ammonia, and urea). The trees were Washington navels on rough-lemon rootstock, in a well-buffered loam. Eight years elapsed before the control trees showed nitrogen deficiency. At this stage nitrogen-uptake had not been influenced by the sources of nitrogen.

The urea treatments were eliminated and the sulphate of ammonia treatments were duplicated. Superphosphate treatments at two levels (12 and 24 lb/tree) were then superimposed on some of the sulphate of ammonia treatments, for comparison of the effects of nitrogen with and without superphosphate on fruit quality. These treatments have continued until now. Present leaf analyses indicate that uptake of phosphate has been negligible.

No potash has been applied but the depressant effect on potash, of both nitrogen and phosphate, is quite marked.

The long-term effects of nitrogen treatments show a significant increase in yield (about 40 per cent) due to sulphate of ammonia. The 4 lb rate of sulphate of ammonia appears close to the optimum, as yield increase by the 8 lb rate seems negligible. Fruit from the no-nitrogen treatment has slightly better appearance and quality but size and numbers have considerably decreased. There has been only slight fruit-quality improvement where phosphate is being applied in addition to sulphate of ammonia.

Citrus Juice-Quality Investigations

Regular samples of Washington Navel and Valencia oranges were forwarded to the CSIRO Division of Food Preservation for juice quality determinations, from the variety and rootstock trials at Dareton, Yanco, and Narara Stations. The samples were collected fortnightly throughout the season from standard varietal-budlines on the rough lemon, sweet orange and trifoliata rootstocks at each Station. The main objects are a recording of juice qualities over several seasons, and a close watch on fluctuations in the levels of limonin, the bitter element. Occasional high recordings of limonin in the past have caused juice-processors concern. Data have now been accumulated for two full seasons.

Sterilization of Grapefruit for Fruit Fly

Investigations on ethylene dibromide fumigation of grapefruit were completed this year at the Citrus Wastage Research Laboratory, Gosford. An extensive series of 2-hour fumigations at 70° F resulted in a total of 20,246 larvae killed at 14 oz EDB/1,000 cu ft dose, and 21,546 larvae killed at the 18 oz dose, with no survivor at either dose. There was no indication of rind injury on the grapefruit this season. In a previous season, rind injury was observed from similar doses.

Although the larval-mortality data indicated that disinfection of grapefruit was possible with EDB fumigation, the Fruit Fly Commodity-Treatment Committee decided against recommending the treatment of grapefruit, because of rind-injury risk. The evidence has been made available to the Commonwealth Department of Primary Industry and the State Departments of Agriculture who may wish to specify conditions for use of the method with selected lines of fruit.

De-greening of Mandarins

In de-greening trials with early varieties at the Citrus Wastage Research Laboratory, Unshiu mandarins were de-greened using intermittent charges of ethylene at the concentrations recommended for oranges (200 p.p.m.). However, treated fruit had pronounced off-flavour. This suggests future use of lower concentrations. Emperor mandarins were successfully de-greened, at 80° F for three days using intermittent charges of ethylene down to 50 p.p.m., but there were instances of rind injury.

Pre-harvest Drop in Citrus Trials

The pre-harvest drop trials on Washington navels and grapefruit at the Horticultural Research Station, Dareton, were continued. These included a comparison of 2,4-D and M.C.P.A., different timings, and repeat sprays. M.C.P.A. was unimpressive and for future investigations has been replaced by other treatments. The iso-propyl ester of 2,4-D has now been added to the list of treatments. So far the superiority of 2,4-D as a stop-drop spray, the importance of timing the initial spray in mid-May, and that repeat sprays have little effect, are apparent.

RESEARCH—POME FRUIT INDUSTRIES

Growth Retardant

Trials with a growth-retardant spray ("Alar") in the Bathurst and Orange districts confirmed the sensitivity of Jonathan apple shoots to this chemical. November sprays retarded Jonathan fruit-size, whilst a carry-over effect from previous season's sprays delayed blossoming. Treated fruit showed no differences in cool-storage behaviour, although a previous trial suggested less internal breakdown.

Dwarfing Rootstock for Pears

At Bathurst Agricultural Research Station there is a preliminary trial to determine the compatibility of a number of pear varieties on Forbes quince rootstock, which is expected to produce dwarf trees. Growth of Beurre Bosc and Josephine have been unsatisfactory and Packham's Triumph is little better. Williams Bon Chretien and Winter Cole are still growing well after two years. A hedgerow planting using the two latter varieties is now planned.

Internal Breakdown of Apples

Jonathan apples were held at 30° F, and initially at low relative humidity (60 per cent–70 per cent), for periods of up to 10 weeks, at the Fruit Preservation Research Laboratories, North Ryde. As expected from previous work, the data suggested that breakdown decreased with an increase in weight-loss. The objection that low humidity causes the fruit to shrivel

excessively was overcome in the experimental work. This was by storing fruit at high humidity after the desired weight-loss was obtained. Analyses of data from controlled atmosphere storage, whilst incomplete, appear to confirm that the relation between breakdown and weight-loss also holds under these storage conditions.

Chemical Control of Superficial Scald of Apples

In trials at the North Ryde Fruit Preservation Research Laboratories, dipping before storage showed diphenylamine to be twice as effective as ethoxyquin, and 8-9 times more effective when applied to the trays of the traypack-carton. Both chemicals have now been approved under the N.S.W. Pure Foods Act.

Control of Rots in Cool-Stored Pears

No apparent control of *Penicillium* rots in Winter Cole pears in cool storage was obtained, using wraps impregnated with ortho-phenylphenate acetate. In a pilot test with Packhams pears at 20°C, there was good control by dipping in a thia-bendazole preparation. Further work on this fungicide is proceeding.

RESEARCH—GRAPE INDUSTRIES

Effect of Growth Retardant Foliage Sprays on Fruit Set

At Griffith Viticultural Research Station sprays of 600 p.p.m. CCC and 4,000 p.p.m. B9 (both growth retardants) were compared. These were applied to Gordo Blanco vines on three different dates before flowering, to improve fruit-set. B9 had no effect on set or yield. CCC applied either on 4th or 11th November significantly increased set by 50 per cent, but berry size was proportionately reduced. Consequently the yield of CCC-sprayed vines was similar to that of the unsprayed vines. During February when soil moisture became a limiting factor, sprayed vines wilted and some died—particularly those treated with CCC.

Wine Grapes Pruning, Training and Spacing

A series of permanent experiments was planted at Griffith Viticultural Research Station in 1962 to determine best methods of pruning, training and spacing of three major wine-grape varieties. The experiments had reached a stage where all planned treatments could be applied during the 1966-67 season. Yield results for the 1967 vintage were as follows:

- (1) *Black Shiraz*: Differences between T-trellis and single-wire trellis were significant, for all pruning methods. Vines trained on T-trellis yielded 9.0 tons per planted acre, compared with 8.0 tons on single-wire trellis. There was no significant difference between the spur, rod, hare's ear and modified rod and spur-pruning methods tested. The main contributor to higher yield of vines on the T-trellis was the higher number of bunches, through being able to leave more buds per vine (up to 120) at pruning.
- (2) *Semillon*: Spur-pruned vines on T-trellis yielded 12 tons per planted acre, compared with 10 tons on single-wire trellis. Vines pruned to 3 rods on either T or single-wire trellis yielded 12 tons per acre. This illustrates that vines on single-wire trellis can yield as well as those on T-trellis provided the same number of buds are left at pruning.
- (3) *Gordo Blanco*: There was no yield difference between vines pruned to four different bud-numbers, ranging from 10-32 per vine. Training on T-trellis gave small yield increases. However, vines planted four feet apart in the rows yielded 11 tons per acre, compared with only 8 tons per acre for vines planted 7 feet apart in the rows.

Irrigation Research

Treatments were applied in the 1966-67 season, for the first time, to a major experiment designed to study the effect of frequency and timing of irrigation on yield and quality of Black Shiraz wine grapes. The experiment was planted in 1963 at the Viticultural Research Station, Griffith. Vines receiving two irrigations during the growing season yielded less than vines receiving ten irrigations but differences were not significant. A water-table present at 5-7 feet during the growing season may have augmented the water supply of the less-frequently irrigated vines.

Root-Chamber Investigations

In the 1966 winter a root-chamber was designed and a prototype built. This is to observe the effects of varying moisture levels, temperature, etc., on grape root-growth. The chamber has many advantages over more conventional root-chambers. The main one is that the effect of immediate moisture environment on root-growth can be studied. Great flexibility of moisture environment is possible with this apparatus. During 1967-68 a larger and permanent root-observation chamber of the same type will be built.

Gibberellic Acid Sprays Increase Yield of Dried Sultanas

In trials at the Dareton Horticultural Research Station the dried-weight yield of sultanas was increased by up to 20 per cent by application of the growth-promoting hormone gibberellic acid (G.A.) at the shatter stage of inflorescence development. Yield increased with the concentration of the spray up to the maximum of 50 p.p.m. used. A combination of 10 p.p.m. G.A. and 10 p.p.m. P.C.P.A., another growth regulator, applied seven days after shatter, gave a greater yield increase than 10 p.p.m. G.A. alone. Increased berry size was responsible for the higher yields of treated vines and accordingly drying time was extended by a few days. Treatments also slightly delayed maturity.

Gordo Blanco Productivity

Research towards improving the productivity of Gordo Blanco grapes, especially in the Murray River districts where the variety is mostly dried for raisins, was started at the Dareton Horticultural Research Station. Forty-nine vigorous and productive clones, selected from commercial vineyards, were planted to compare their merits. Also another experiment has been established, to evaluate nine different rootstocks for Gordo Blanco.

Wine and Table Grape Variety Improvement

The wine and table grape improvement-programme, started in 1962 at Griffith Viticultural Research Station, continued to expand. By the 1967 winter, 58 new varieties and clones had been introduced for testing. Also, six new rootstock varieties have been obtained. Most of the introductions are from California and Europe. Some have come from other districts in Australia. The wine and table grape industries are displaying keen interest. Substantial quantities of cuttings obtained from Europe have been released already to vignerons. Varieties in most demand are those suited to making high-quality table wines and include Chardonnay, Gewurz Traminer and Pinot Noir.

Export-Packing of Grapes

Experiments continued at Griffith and the North Ryde Fruit Preservation Laboratories, towards increasing the export-life of various table-grape varieties. Several major varieties (e.g., Waltham Cross, Purple Cornichon and Gordo Blanco) are permitted for export only when the sea-journey does not exceed seven days. This greatly limits the expansion of export-markets.

This year's results from experiments show that the period could be safely extended. The standard Australian export-pack, using granulated cork packing, and the South African export-pack, using bunch wraps and special sulphur dioxide tablets, kept the grapes in good marketable condition for periods up to eight weeks.

RESEARCH—TROPICAL FRUIT INDUSTRIES

Banana Nutrition

Data for the second cut from the banana-nutrition trial at Alstonville Tropical Fruit Research Station have been analysed. The significant effect of potassium on leaf-longevity which was apparent in first-cut data was not evident on the second-cut. Yield-gradients found in the block initially are still demonstrated by bunch-weight data.

The range of phosphorus values in banana leaves has been found to be not always as variable as with the other major nutrients. Soil-phosphorus levels are not necessarily related to leaf-phosphorus levels. High levels of soil-phosphorus could be adversely affecting other nutrients such as potassium nitrogen, and zinc, and might be contributing to nutritional problems in bananas.

Potash deficiency has been determined in chocolate-basalt soils west of Lismore, and magnesium deficiency in the Brunswick district.

Indications overall are that general fertilizer-practices should involve high nitrogen, low phosphate and high potash complements.

Banana Plant-Soil Moisture Relations

Water-restriction to the planting at Alstonville Tropical Fruit Research Station was completed for these studies. The plant physiology and water budget-yield sections of the trial are now proceeding. Unfortunately, the block was badly hit by cyclone "Dinah" in January, 1967. This led to some re-arrangement of plots.

Banana Herbicide Trial

Diuron appears the most effective of the pre-emergence herbicides in the trial at Alstonville Station. No phytotoxic effect was noted. Arsenic remains the most effective post-emergence ("knock-down") treatment. Yield from the various treatment-plots are being recorded.

Pineapple Decline

In the preliminary work at Alstonville Station the ethylene dibromide pre-plant fumigation gave initial control of nematodes, but build-up was substantial after 12 months. Pre-plant soil-treatment with parathion tended to inhibit plant growth, without effect on nematode populations. Neither treatment, singly or in combination, controlled the pasture scarab beetle (*Rhopheia*). The second phase of the trial will examine the importance and control of this insect in the pineapple-decline complex.

Miscellaneous Trials

Narara Horticultural Research Station's investigation of seed-grafting methods for propagating the macadamia nut has given encouraging results. The programme has now been extended to Alstonville.

Additions have been made at Alstonville to the macadamia and avocado variety trials. In the avocado and the custard-apple variety trial some of the earliest established varieties have started to crop.

Banana Sterilization for Fruit Fly

Methods have been developed at Gosford Citrus Wastage Research Laboratory to infest bananas with Queensland fruit fly, and several ethylene dibromide fumigation dosage-rates have been tested. Survival has occurred at levels up to 10 oz/1,000 cu ft; 14 to 18 oz/1,000 cu ft appears to offer the required security.

Banana-Maturity Chemical-Index

At Alstonville Station, a good relationship between a proposed chemical-index and banana-maturity is apparent. A peak leucoanthocyanin content was observed in the fruit at about the time of commercial-harvest maturity. Reliability of the chemical-index appeared to be equal to that of physical measurements of fruit size, but natural variations between bunches limit the possibilities of commercial wide-scale application of either method to predict post-harvest life.

Bananas in Polyethylene Bags

In a long-distance transport trial, bananas in polyethylene bags responded favourably to a wide range of atmospheres during a ten-days holding-period. Use of the bags enabled a saving of 1 lb in loss of weight in 30 lb of fruit. Commercial-scale trials are continuing.

Because black-end (*Gloeosporium musarum*) developed in the preliminary studies with bagged bananas, two new fungicides were compared with the sodium salicylanilide standard treatment. Thiabendazole was the most effective. 2-amino-butane was more effective than salicylanilide but caused fruit injury at higher concentrations.

Thiabendazole was also more effective than salicylanilide in controlling crown rot in bananas packed in hands. Toxicological data on the two new fungicides are as yet incomplete. Neither has yet been approved by the Health Authorities.

RESEARCH—STRAWBERRY INDUSTRY

Strawberry Improvement

One selection from the breeding work at Narara Horticultural Research Station has shown outstanding merits and has been released as "Nared". Three other promising selections

are to be further tested. One of these has produced outstanding yields but performance under a wider range of conditions, and its qualities, need more examination before it can be recommended for general planting.

Narara and Rydalmere trials have shown that increased yields can be obtained from virus-tested Kendall plants compared with plants from normal sources, even when there are no visual signs of virus-infection. Therefore steps have been taken to increase supplies of virus-tested plants of both Kendall and the newly released Nared, for industry use. Certified plants of other varieties used in New South Wales are readily available from Victoria.

RESEARCH—STONE FRUIT INDUSTRIES

Variety Improvement

In Trials at Bathurst and Narara some introduced dessert peaches cropped for the first time this year and were examined for fruit-quality characters. Further trials of some of them are now being established on growers' properties in various districts. None of the varieties can be recommended at present but limited quantities of budwood were released to nurserymen for the propagation of trees for growers who wish to orchard-test them.

Budwood of introduced yellow-fleshed nectarine varieties was released from quarantine following screening for virus diseases. The wood has been used for propagation of trees to establish trials in the 1968 planting season.

Useful cropping information was obtained from the canning-peach variety trials at Yanco. Canning quality of a number were evaluated at a canning-fruit conference at Yanco Agricultural College and Research Station in September, 1966. Further samples of all varieties were canned during the season for additional, later evaluation.

Three strains of the Golden Queen Variety, two early-maturing and one late-maturing, have performed as well as the standard strain and should be most useful to extend the harvesting season. Trees of these strains have been propagated for the establishment of bigger district-trials.

Variety trials at Yanco have been extended with the planting of nine recently introduced early-maturing varieties, with a local strain of Stanford and the variety Gaume for comparison.

Rootstocks

Prunes and European plums in all districts have continued to make outstanding growth and to produce well on Buck plum but usually produce slightly smaller fruit. Under good growing conditions where adequate moisture is available, this slight decrease in fruit size is of little consequence. The heavier crops compensate for slightly smaller fruit. Under dry, non-irrigated conditions, however, size differences in fruit are accentuated and there is a need to evaluate the stock further under those conditions.

A selected strain of Marianna has consistently given best results with Japanese plum varieties, particularly in coastal districts.

A minor trial with the rooting of Buck plum cuttings demonstrated to nurserymen at Griffith the correct method of handling this stock. Its popularity for use in the M.I.A. with prunes is certain to improve.

Trials with cherries have demonstrated that both the Malling F12/1 and Deister seedling stocks are more resistant to bacterial canker than is the normally used Mazzard stock. A trial to test the interaction between stocks and the influence of virus infections in cherries is being established at Orange Agricultural Research Station this year.

Results with apricots on Buck plum in a pilot trial at Griffith have been promising. Further trees are being propagated on this stock, to establish more extensive trials.

Prune Nutrition

A trial conducted at Young since 1958 has clearly demonstrated the need for nitrogen fertilizers on prunes. Complete fertilizers containing potash have continued to be superior, in yield-results, to fertilizers containing comparable amounts of nitrogen and phosphorus. The increases obtained from potash were not significant during the first five years but have become more apparent since then. There is enough evidence that economic returns can be expected by continued light applications of potash over a number of years. Light applications have produced results as good as those from the heavier applications.

Post-Harvest Investigations

Investigations into methods of controlling post-harvest rot in stone fruits were initiated. A number of fungicidal dips were evaluated for control of brown rot and rhizopus transit-rot in peaches. The keeping-quality effect of hydro-cooling is also being investigated.

Promising results have been obtained with some treatments, in both peaches and cherries, but more intensive studies are needed to establish the most effective concentrations and methods.

TILE DRAINAGE RESEARCH

Depth and Spacing of Tile Drains

At Griffith Viticultural Research Station, in a major investigation the agronomic responses of citrus, grapes and peaches to various depths and spacings of tile drains are being studied. No critical watertable was encountered during the season. Therefore observed differences cannot be attributed to drainage-treatments.

During the past season, 1½ to 2 surface-inches of irrigation water per 15-day rotation were applied. Less than 50 per cent of this was intercepted by the drains. This level of irrigation resulted in watertable levels below the depth of the drains for most of the season. The lowest watertables were associated with peach plantings. Intermediate levels were associated with vines, and higher levels with citrus. These observations tend to indicate that peaches and vines were intercepting all water applied and may not have received their optimum water-requirements. The watertable pattern indicates that citrus areas contributed most of the drainage effluent.

Drainage effluent-salinity is decreasing despite low leaching-intensities. Plantings in areas with higher effluent-salinity are retarded in vigour. The threshold conductivity-value for growth-depression appears to be about 10 millimhos per square centimetre. High effluent-salinity is reflected in relatively high salinity of the top two feet of soil. Currently salinity-determinations are being done throughout the entire Tile Drainage Depth and Spacing experiment to determine the relationship of soil-salinity to tree-vigour, to discover if further intensive leaching is needed to improve the uniformity of the plantings.

Lysimeter Studies

Further studies at Griffith Viticultural Research Station, using large containers, indicate that peach trees grown under fully drained conditions continue to make good shoot-growth from December through January and into February. Trees subjected to a one-foot watertable ceased shoot-growth within 10 to 12 days of applying the treatment. Trees subjected to a continuous three-foot watertable ceased shoot-growth after about 24 days. Trees subjected to complete water-logging for three days followed by fully-drained conditions at fortnightly intervals ceased shoot-growth after the second water-logging cycle. The only trees showing typical visual symptoms of water-logging were those subjected to the one-foot watertable treatment.

Tile-Line Blockage Investigations

Two compounds were tested at Griffith to check root-inhibitory properties, towards solving the problem of root-blockages of tile drains. This is a very great problem in the M.I.A. Various concentrations of DD were tested on peach seedlings as root-inhibitors but there was no evidence of root injury or inhibition at the concentrations. However, both DD and Coal Ash were found to effectively inhibit root-growth of grape-rootlings. This will continue.

Research Stations and Laboratories

ALSTONVILLE TROPICAL FRUIT RESEARCH STATION

Completion of the first stage of water reticulation or irrigation has enabled full implementation of the banana irrigation trial, and allowed investigations with other plantings to proceed. New plantings were confined to an extension of the banana variety block, and establishment of a small area of pineapples for further studies of pineapple decline.

BATHURST AGRICULTURAL RESEARCH STATION

Extensions have been made to irrigation installations. All sections can now be conveniently watered. Additional peach and plum plantings have been made, to provide for short-term trials and fruit for post-harvest studies. A herbicide trial was started with young apple trees.

Some temporary laboratory facilities have been provided. Provision of a separate laboratory building is under consideration.

DARETON HORTICULTURAL RESEARCH STATION

Two 50-yard grape drying racks were constructed and a hot-dip tank and dip crane installed. This permitted processing of the first sultana crop produced from the new experimental plantings. For the proposed citrus nutrition and soil management investigations, land has been graded and sown to cover crops, irrigation equipment received, and propagations of trees undertaken. Propagations of avocados for the proposed variety trial have also been commenced.

New equipment included an electric calculator for data processing, and a potentiometer for thermocouple recordings of soil temperatures in the citrus spacing trial.

GOSFORD CITRUS WASTAGE RESEARCH LABORATORY

Operated in co-operation with the CSIRO Division of Food Preservation the laboratory continues to investigate the preservation and handling of citrus fruits after harvest, and fruit fly disinfestation studies. New projects relate to improved fungicides for control of moulds and rots in oranges and lemons, investigation of fruit cleaning with modern detergents, and of banana sterilization against Queensland fruit fly.

GRIFFITH VITICULTURAL RESEARCH STATION

A major extension to plantings took place with the planting of variety trials for wine grapes. This work will now be a major portion of the Station's activities.

Construction of a new building to incorporate laboratories and an experimental winery is under consideration. The latter is essential to assess the wine-making quality of new varieties introduced and to evaluate effects of cultural treatments on wine quality.

NARARA HORTICULTURAL RESEARCH STATION

A new area has been developed for permanent establishment of indexing material for the deciduous fruit tree improvement work, and areas are being maintained for the intended virus indexing work. A close planting of over 700 grapefruit trees was made as an extension of investigation of the stem-pit virus.

Hybrid passionfruit plants have been received from the Queensland Department of Primary Industries for a pilot planting.

NEW ENGLAND AGRICULTURAL RESEARCH STATION

The established trials with apple rootstocks and strawberries were continued. A variety collection of hazel nuts was maintained. Some specially imported virus-free Mahaleb cherry trees were established in isolation, to supply virus-free rootstocks.

NORTH RYDE FRUIT PRESERVATION RESEARCH LABORATORY

Co-operative cool storage investigations on fruit were continued with the CSIRO Division of Food Preservation. An additional cold room was provided, and also infra-red gas analysis apparatus for accurate measurement of low levels of carbon dioxide.

ORANGE AGRICULTURAL RESEARCH STATION

Allocation of land for horticultural use was made this year. Four plantings are being established this winter for an apple spacing, variety and rootstock trial, plant growth regulatory studies, cherry virus studies, and studies of the effect of tree nutrition on apple storage quality.

YANCO AGRICULTURAL COLLEGE AND RESEARCH STATION

Ten more imported canning peach varieties were planted for the early maturing section of the replicated variety trials. Two new citrus trials concerned with herbicide management systems and dwarf tree studies were started. Some more departmentally bred citrus hybrids were planted for field testing.

Committees Affecting Research

Co-ordination of Fruit and Vegetable Processing Research

This Committee comprises representatives of the CSIRO, the Department of Agriculture, and representatives from the Canning Industry. Two meetings were held. The discussed matters of importance to New South Wales were apricot breakdown, cherry canning, and prune dehydration.

Deciduous Fruit Tree Improvement

The Committee, comprising officers of the Division of Horticulture and the Biology Branch of the Division of Science Services, aims to prevent the spread of virus diseases—by selection of propagating material. A collection of a wide range of virus-indexing plants has been established. Testing of cherries and other fruits has been commenced. Building up of sources of proved virus-tested material has progressed.

Cudgell/Coleambally Citrus Survey

At a meeting between the Executive Research Panel of the I.R.E.C., the Department of Agriculture, and the CSIRO to discuss the poor growth of citrus at Cudgell/Coleambally, it was agreed to form a Citrus Survey Committee to investigate the problem. The inaugural meeting of the Citrus Survey has been held, with the Department's Citrus Specialist as chairman. A survey will be conducted on all properties, by representatives of the Division of Horticulture, the CSIRO, and the W.C. & L.C., to determine the main causes of the problem and to guide research investigations. The Committee also decided to acquire soil from the typical Sandmount series of the area for preliminary nutritional screening pot trials at Rydalmere.

Sunraysia District Citrus Co-operative Society Ltd Citrus Problems Committee

Representatives of the State Agriculture Departments of N.S.W., Victoria, and South Australia, the CSIRO, and Irrigation Authorities, meet annually at Mildura to discuss and report on citrus problems and on research problems pertinent to the Murray River districts. The S.D.C.C.S. Ltd Citrus Problems Committee also organized a conference to discuss the commercial adaptation of citrus leaf analyses as a guide to citrus fertilizing.

Citrus Improvement Committee

The Citrus Improvement Committee met twice this year to discuss progress of projects investigating the complex of citrus viruses and other diseases as affected by stock, scion, and strain selection; virus- and disease-indexing; and variety improvement. The Committee also organized propagations for future research work, including propagations for an assessment of various grapefruit and grapefruit types likely to be useful for processed juice and canned segments.

Fruit Cool Storage Investigations

This Advisory Committee met to consider the results and projected programmes of investigations on fruit storage, citrus wastage and plant physiology investigations being done by the CSIRO, Department of Agriculture and University of Sydney. A sign of increased interest in the post-harvest physiology of fruit was a report of fundamental studies on the nature of the ripening processes in fruit.

Vine Improvement Research

This Committee was formed by the Horticultural Research Section of the CSIRO in 1965 to advise and assist the CSIRO in its grape research programme. It includes representatives of State Departments of Agriculture, the Australian Wine Research Institute, Federal Grapegrowers Council and Australian Dried Fruits Association. A meeting-highlight was the presence of Mr M. Rives, Director of the Viticultural Research Station, Bordeaux. He visited Australia for three months at the invitation of CSIRO and State Departments. One of his main recommendations was that greater emphasis be placed on clonal-selection in viticultural research programmes in Australia. In Europe, selection and planting of high-yielding clones had led to big increases in vineyard-productivity.

Banana Research

This Advisory Committee comprises representatives of the Commonwealth Department of Primary Industry, the States of New South Wales and Queensland, the Australian Banana Growers' Council, and the CSIRO. Funds are contributed by the industry and the Commonwealth Government. Recommendations for allocations to the various research projects

are made through the Committee to the Commonwealth. Projects on post-harvest banana research have been commenced at the Tropical Fruit Research Station at Alstonville, the Hamilton Research Laboratories in Queensland, and the CSIRO laboratories.

Canning Peach Conference

A Canning Peach Conference was conducted by the Division of Horticulture in September, 1966, at the Yanco Agricultural College and Research Station. Industry trends and the Yanco research programme were discussed; variety performances were reviewed, and canned samples were assessed. Fruit growers organizations, also New South Wales and Victorian canneries, the Victorian Department of Agriculture, the CSIRO and the New South Wales Department of Agriculture were represented there.

Citrus Wastage Research

This is a subcommittee of the Advisory Committee on Fruit Cool Storage Investigations in New South Wales. It comprises representatives of this Department and the CSIRO Division of Food Preservation. It met twice this year, to review the research programme of the Citrus Wastage Research Laboratory and direct the activities. The Committee arranged two extension schools; one attended by thirty horticultural officers from State Departments of Agriculture and the other by sixty commercial packing-house operators from the citrus-producing States.

Fruits Disinfestation

This Committee was formerly known as the Fruit Fly Commodity-Treatment Committee. It was re-named by the Standing Committee on Agriculture in February, 1967, so that its future investigations could include a number of fruit and vegetables and a range of insect pests. The Committee includes representatives of the Department of Primary Industry, the CSIRO and the State Agriculture Departments of Victoria, Queensland, South Australia, and New South Wales.

It has made its recommendations in respect of oranges, lemons, mandarins, and grapefruit and the work with citrus has been terminated. The committee is now conducting investigations on the post-harvest sterilization of bananas against Queensland fruit fly. Finance for a three-year programme is being provided by the Commonwealth, the Australian Banana Growers Council, and all State Departments of Agriculture.

Central Coast Agricultural Research and Extension

The aims of this Committee are to co-ordinate agricultural research and extension activities in the Gosford/Wyong districts. The Committee continued to expand its activities during 1966-67. It stimulated interest in herbicide trials for the district, the investigation of citrus blemish, and the design of suitable spray-plant for the district.

M.I.A. Irrigation Research and Extension

The I.R.E.C. comprises representatives of various Divisions of this Department, the CSIRO, other State Government bodies, trading banks, industry and grower representatives. Its main activity is to co-ordinate research and extension activities in the M.I.A.

The usual census of fruit plantings in the M.I.A. was not undertaken and the possibility of conducting it biennially instead of annually is under consideration. Of special interest to this Division was the constitution of a Horticultural Subcommittee to activate interest in new fields requiring research and extension. This season further research on herbicide management-systems with citrus was recommended.

Co-ordination of Fruit and Vegetable Storage Research

This Commonwealth Committee held its biennial meeting at Perth. A representative from New Zealand attended by invitation. Discussing developments in plant physiology, biochemistry and fruit storage, special interest was drawn by evidence that alpha-farnesene, found in the natural coating of apples, has a causative role in the important apple storage-disorder superficial scald. Seemingly, partial removal of this volatile substance by air movement and by oiled wraps, could explain these two methods' reduction of scald-development.

Apple and Pear Spray Residue

This Committee comprises representatives from the Commonwealth Department of Primary Industry, the CSIRO, and the Tasmanian, Victorian, and New South Wales Departments of Agriculture and is involved with investigations relating to

field-spray residues. The Committee has installed at Bathurst Agricultural Research Station an experimental wet- and dry-processing unit for residue-removals. The unit has ten types of brushes and has variable brush-speeds and movements. A series of trials was completed and residues from the various treatments are being assessed.

Extension Services to Fruit Industries

REVIEW OF EXTENSION ESTABLISHMENT

Creation of the Principal Fruit Officer (Regulatory) position has enabled the Principal Fruit Officer (Extension) to concentrate on the Division's extension services. These were critically examined and action was taken to reorganize certain aspects.

Staff Training

Because of the high ratio of young officers in extension (almost 50 per cent under thirty years of age) and the urgent need to expedite recruitments, staff training has assumed high priority. Preliminary arrangements have been made to accelerate the training programme through short-term schools and concentrated in-service training in narrower fields.

Achievement Targets

The Division has launched a system requiring each District fruit officer to aim to achieve specific targets by his extension work. As a result the Division's extension activities overall have been co-ordinated and directed toward specified objectives. The system will facilitate appraisals of the Division's extension programme, and evaluations of methods used.

EXTENSION UNDERTAKINGS OF PARTICULAR INTEREST

Fruit Packing, Presentation, and Marketing

An intensive extension campaign has been conducted in most districts towards better and more modern fruit packing and presentation. During the last two years there have been 65 field days, demonstrations, and lectures dealing with all

aspects of packaging and marketing. An example of success is that 70 per cent of tomato growers from northern districts have changed from orthodox pattern-packing methods to the volume-fill and greatly reduced their labour costs. Another is provided by the Kurrajong stone fruit growers. Their introduction of standard markings for apricot packs, and their improved presentation, have been rewarded by the response from agents and retailers.

A special feature of 1966-67 was the outstanding fruit presentation display staged by Divisional officers at the Orange National Field Day where more than a thousand interested growers took heed of it.

Prune District Survey

A detailed survey of prune orchards in the Young district was conducted to provide a basis for formulation of future policies for the district's prune industry. Information on the age grouping and health ratings of all prune plantings in the area was obtained. It has shown that of the 2,597 acres in the district, 1,821 acres were planted before 1930 and most were planted immediately the soldier settlements for fruit growing were established following the 1914-18 war. The early plantings are now in various stages of decline and could not long remain profitable.

Increased plantings are needed if this district's prune production level is to be maintained. A report on the survey will shortly be available to industry leaders.

Extension by Television in Murray Districts

Television transmission has become a factor in the Sunraysia dried fruits districts. Officers of the Division of Horticulture in co-operation with the Victorian Department of Agriculture have organized a weekly half-hour television programme directed mainly to fruit growers. Programmes are organized three months ahead and officers of the two Departments participate equally. Subject-matter has included improved irrigation procedures for grapes, testing of grape maturity, use of hormone sprays to improve table grape quality, nutritional sprays for citrus, citrus quality, care of young citrus trees, and pest and disease control.



Specialized Orchard-machinery Field Days

The Department's fruit officers and farm-machinery advisory officers collaborated with equipment manufacturers/distributors in staging a number of well-received field days devoted to orchard-machinery developments

Apple Spray Warning Service

The spray warning service for apple growers has been improved by use of surface wetness recorders at Batlow and Orange in conjunction with Hirst spore-traps. They enable more precise determination of spore discharge periods. Weather conditions were more conducive to black-spot infection than for many years past, but losses from this destructive disease were kept low.

Interstate Field Day on Grapevine Research

Officers participated in a major interstate field day at the CSIRO Horticultural Research Station, Merbein, to help bring the research projects to growers' attention. About 500 grape growers from N.S.W., Victoria, and South Australia attended. New South Wales officers' talks and demonstrations included results of the research on wine-grape pruning and training, and the effect of gibberellic acid sprays in raising the yield of sultana drying-grapes.

Banana Beetle Borer Control

Identification of banana beetle borer in the Coff's Harbour and Nambucca areas and further new light infestations have rapidly increased growers' awareness of the pest's importance there. A campaign financed by the Banana Growers' Federation and directed by this Division is in full operation, to "contain and control" beetle borer by means of thorough survey, identification, and immediate treatment with dieldrin ground sprays. Grower co-operation and response have been excellent.

Central Coast Agricultural Research and Extension Committee

Initiated by local people in 1963-64, this Committee has been assisted by Divisional officers, in its internal administration and its conduct of field days. This year the field days were on citrus orchard design, planting of citrus orchards, tomato grading, plantings of softwood timbers, and orchard spray machinery. Officers are presently surveying the efficiency of use of citrus spray equipment. The survey may be followed by development of specially designed equipment.

Numerous articles have been provided by officers for the Committee's bi-monthly bulletin.

Schools on Post-harvest Handling of Citrus

Two extension schools on developments in fungicidal treatments and post-harvest handling of citrus were conducted at the Citrus Wastage Research Laboratory. The first was for officers of the South Australian, Victorian, Queensland, and N.S.W. Departments of Agriculture. The second was for packing-house operators and was attended by 60 from the various States except Tasmania and Western Australia. Ethylene dibromide for sterilization of fruits likely to be infested with Queensland fruit fly was also discussed in detail. The special interest was its importance in permitting fruit exports that otherwise could not be made.

Packing Grapes for Export

An extension campaign was conducted in the M.I.A. to improve the packing of export grapes, to reduce the quantity rejected from export through faulty packing. The most common faults have been insufficient granulated cork in the packs and the bunch damage due to rough handling. Packing demonstrations were conducted and local television also gave good coverage.

Citrus Nutrition Survey

The citrus nutrition survey has now been in progress for three of the five years' programme in Gosford, Windsor, M.I.A., and Murray districts. The Citrus Nutrition Committee recently considered the results for 1966-67 with District officers and again made fertilizer recommendations for the surveyed orchards. The data so far collected are being programmed for the Public Service A.D.P. unit, towards getting maximum value from the survey.

Distribution of High Yielding Sultana Clones

Lower Murray District fruit officers working in co-operation with the CSIRO and Victorian Department of Agriculture have implemented a scheme for distribution of high-yielding sultana clones to growers. The clones were selected and recently released by the CSIRO. Thirteen mother blocks of the clones have been established in the district under Departmental officers' supervision. This is to ensure purity of the plantings and provide permanent sources of cuttings for nurserymen and growers. Use of proven high-yielding clones is a new development in the industry. Soon they are likely to be the only ones used for new plantings.

Fruit Industry Trends

CITRUS INDUSTRY TRENDS

Seasonal Effects on Production

Districts dependent on rainfall had satisfactory production conditions since the drought broke in the spring of 1966. In the dry winter prior to the break of the drought some frost injury to young trees occurred in all districts but frosts were not so severe as to cause much fruit damage.

Excessive December-drop of Navels and Valencias in the Murray areas through tornado-type storms reduced crop prospects by 25 per cent. Heavy late-summer rains caused a heavy drop of premature Navels in Gosford district.

Total citrus production of 1966-67 was 5,900,600 bushels, a considerable increase over the 4,640,000 bushels for 1965-66 and largely influenced by the record Valencia crop of 1,346,000 bushels in the M.I.A. This volume of M.I.A. production of Valencias is likely soon to be the norm there. A varietal break-up of the total citrus production was as follows (in bushels): Navels 1,601,500, Valencias 3,493,000, Commons 28,600, Seville 18,500, Lemons 427,000, Mandarins 189,000, Grapefruit 143,000.

The present estimate of total production for 1967-68 is 5,580,000 bushels.

Trends in Lemon and Mandarin Plantings

Heavy demand on the relatively light crops of lemons typical of the past few years has increased the coastal interest in planting lemons. The factor most limiting expansion is suitable new land with good drainage, since only rough-lemon stock is recommended.

Removal of declining Emperor mandarin plantings continued in the Windsor/Maroota districts. New mandarin plantings in this area favour Ellendales and Hickson. Supply of Hickson trees cannot meet the demand.

Citrus Processing

The proportion of the citrus crop being processed has rapidly increased. In most districts demand exceeded supply. In Gosford district most of the lemon crop and about half of the Valencia crop were processed. At Leeton about one-third of the Valencia crop was processed. Leeton Co-operative Cannery processed 2,142 tons of the Valencias from trees on trifoliata stock. Leeton Cannery was unable to fill its requirements of 350 tons of grapefruit for juice and segment-canning.

Citrus Packaging and Marketing

There was again much interest in development of suitable containers. Competition between carton-manufacturers was increased. A positive requirement was stipulated in South Australia that all export fruit be packed in the wire-bound "Bruce Box". This trend spread to the Murray districts of New South Wales and Victoria. The dump-bushel formerly common in the Murray districts has now disappeared, and standard bushel-cartons are in general use for local markets. There is also definite interest in the 4/5th bushel carton.

The trend away from the narrow-mouth dump-case to standard bushel design has been accompanied by a swing to the rapid-pack techniques. The needed special fruit-sizing plants are being installed in many of the co-operative sheds in the Murray districts.

Citrus Export Trends

The M.I.A. made effective use of export markets within the limits of EDB fumigation requirements and exported 134,000 bushels. Over 151,000 bushels were exported from packing houses on the New South Wales side of the Murray River and if the New South Wales fruit packed in Victoria were added the export total for this district exceeded 200,00 bushels. The majority of export shipments were "picked" as opposed to the general export-requirements of "clipped" fruit. This yielded considerable saving in harvesting expense, and most reports of the outcome were favourable.

Organization of Citrus Marketing

There has been partial success in organizing citrus marketing. Two Area Marketing Boards are being formed. One was established for the Sunraysia districts, on the New South Wales

side of the Murray River, and this Board seems likely to co-operate with a proposed Victorian Board—through the Sunraysia Districts Citrus Co-operative Society Ltd. A poll of growers in the Gosford/Wyong Central Coast Districts was also successful. The grower-members are now being elected for this Central Coast Board.

The ultimate aim of the Australian Citrus Growers Federation is to have a Marketing Board for each State, and a Federal Board to organize Australian citrus-marketing. This might be simple for most States, but in New South Wales there seems to be resistance to board-control in certain areas.

GRAPE INDUSTRY TRENDS

Record Wine and Wine-Grapes Production

Production of wine grapes in New South Wales for the 1967 vintage is estimated at 47,500 tons, considerably more than the previous record of 41,839 tons (in 1966).

In the M.I.A., the State's largest wine-producing district, a record crop of 41,669 tons was harvested compared with 34,929 tons in 1966. Tonnages of the main varieties were: Semillon 6,987, White Shiraz 6,695, Black Shiraz 6,272, Doradillo 5,394, Grenache 4,215, Palomino 2,694, Pedro Ximenes 2,486, and Gordo Blanco 1,952.

Hunter Valley production of wine grapes is estimated at 1,800 tons comparable with the big crop of 1,853 tons in 1966. Yields from some vineyards were significantly reduced by the prolonged drought but production from new vineyards coming into bearing will offset the effect on the total.

In the Corowa/Barooga district 1,279 tons were harvested. This is lower than normal. In the New South Wales part of the Sunraysia district, on the Murray, conditions were excellent and production well above average.

Total wine-production in New South Wales for the 1967 vintage will be a record; expected to be around 7,500,000 gallons as against the 6,425,674 gallons in 1966.

Trends in Wine-Grape Plantings

The rapidly increasing demand for table wines in Australia has created shortage, particularly of reds. It has fostered interest in the planting of wine grapes in New South Wales districts. These districts are favoured by proximity to the main markets in Sydney and Melbourne.

A census in the M.I.A. has disclosed 5,939 acres of wine grapes in the district at December, 1966. Of these, 1,092 acres are as yet non-bearing. The total presents a net gain of 241 acres since December, 1965.

The M.I.A. Wine Grapes Planting Advisory Committee comprising representatives of winemakers, wine-grape growers, and the Department of Agriculture has recommended further plantings of Semillon, Black Shiraz and Gordo Blanco varieties for the 1967 winter. Winemakers have stated that on present indications their need of grapes will increase to at least 50,000 tons per year by 1970.

In the Hunter Valley substantial new areas have been planted. This trend is likely to continue for some time. Most of the production is still in the Pokolbin area, but establishment of the large and modern winery at Muswellbrook opened by the Prime Minister early in 1967 has led to significant private plantings in this area.

Trends in Wine Grape Prices

Prices for wine grapes in the M.I.A. were increased for the 1967 vintage. The most significant were \$4 per ton rises for the important Black Shiraz and Semillon varieties. Prices, for main varieties, were Black Shiraz \$62 per ton, Semillon \$60, White Shiraz \$48, Doradillo \$41, and Grenache \$47. In some instances the paid prices were higher than those agreed to between Wine Grapes Marketing Board and the M.I.A. Winemakers Association. Competition between wineries to obtain grapes was considerable. This led to many instances of bonus payments.

Although most vineyards in the Hunter Valley belong to winemakers, private vineyards are increasing and thus the quantity of grapes sold to winemakers is expanding. Wine grapes in the Hunter Valley are the most highly-priced in Australia and, depending on the variety and the particular vineyard's location, prices ranged from \$200 to \$280 per ton for the 1967 vintage.

Record Dried Vine-Fruits Production

Production in New South Wales in the 1966-67 season was a record 14,951 tons (dried-weight), compared with 11,929 tons in 1965-66. The break-up into types, in tons: currants 637, sultanas 12,575, raisins 1,738 tons. Overall, the quality was excellent.

Dried Vine-Fruits Industry-Outlook

About 80 per cent of Australia's production of dried vine fruits goes to overseas markets and the industry is apprehensive of the future marketing situation. This is in view of the increasing world-production of sultanas, the effects of the Kennedy Round reduction in tariffs, and the possible entry of the United Kingdom into the European Economic Community.

Two factors have been contributing to stability of the dried-fruits industry and satisfactory returns to producers in recent years: successful operation of the International Sultana (Raisin) Agreement Conference, and the 1964 adoption of the Dried Vine Fruits Stabilization Plan.

World-production of sultanas is about 100,000 tons more than can be sold and there were doubts that signatories to the International Sultana Agreement would agree on minimum export-prices for the 1966-67 production. However, it eventuated that the Conference held in Izmir, Turkey, strongly supported an extension of the minimum-price agreement. This should ensure stability within the industry at least in the short term. Moreover, it became apparent that much of the surplus production of sultanas was of substandard quality and could not enter world trade.

As a result of the Kennedy Round, it appears that the reduction in tariff preferences for Australian dried vine-fruits on the Canadian and United Kingdom markets will be largely offset by advantages gained on markets in continental Europe. The overall effect of developments so far is that price-stability is likely to be maintained but the industry attitude is caution regarding expansion of production of drying-grapes. This is particularly so in view of the doubt about the future of the United Kingdom market which is at present Australia's main outlet.

Equipment Trends in the Dried Vine-Fruits Industry

Bulk Bin Dehydrators. In the Lower Murray districts there is considerable interest in adoption of bulk-bin dehydrators to finish off the drying. Use of the dehydrators avoids spreading the sultanas on ground-sheets. Thereby grit-contamination is reduced, and the fruit can be dried to the correct moisture-level irrespective of outside temperatures or rain. Cost of the machines, about \$400, is well within the reach of most growers.

Metal Detectors. For the first time, all packing houses were this year required to provide metal-detectors in their dried fruits packing-lines. This has significantly improved the Australian pack, as an unbelievable amount of metallic objects otherwise get into dried vine-fruits. New Zealand buyers in particular have appreciated this equipment-development.

Lower Table Grapes Production

Production in New South Wales for 1966-67 is about 7,000 tons, compared with 7,699 tons in 1965-66, and well below the 1964-65 record 8,251 tons.

The season in the early table-grape districts near Sydney was one of the worst ever. Considerable rain in the harvest period was one factor. Another factor was the extensive losses for the first time caused by the physiological disorder "bunch-stem die-back". This disorder has become increasingly serious in Europe and could do so also in Australia.

Production in the M.I.A. was lower than normal; only 290,691 half-bushels sold as fresh fruit, compared with 374,737 in 1965-66.

The quantity of sultanas sold as fresh fruit from the Murray districts has notably increased over the last four years, and this trend is likely to offset to an extent the lower production of table grapes by early districts near Sydney. To a large extent the increase can be attributed to the work of local officers in helping to improve quality and presentation. Also, consignment of immature grapes to market has decreased because of publicity and the Department's maturity-testing service.

Emphasis on presentation has created a greater awareness of container-effect. The wooden $\frac{1}{2}$ -bushel case is now less used. The carton and the $\frac{3}{4}$ -bushel wooden-case are more used. Unfortunately, prices this season were not up to expectations and only top-quality fruit brought reasonable returns.

POME FRUIT INDUSTRY TRENDS

Record Production

Apple and pear production for the 1966-67 season was about 3,423,000 and 619,000 cases, respectively; the highest ever recorded in this State. This record should not stand very long, since at least one-third of the total acreage is of trees under ten years old—in good districts.

Pear production will not increase to the same extent as apples, but by 1970 should reach three-quarters of a million cases. Apples by 1970 should be in the range of 3½ to 4 million cases.

Pome Fruit Planting Trends

In most districts growers are now realizing that there are limits to profitable absorption of apples and pears. The past two dry-years have also curbed optimism. New planting has slowed down in all main districts. This is not so in the areas near Sydney, where a high proportion of the growers are city men not fully appreciating the economics of the industry; for example, in Bilpin's total of about 1,500 acres there are 1,000 acres under ten years old—and at least another 100 acres will be planted there this winter.

Effect of Rising Costs, on Methods

Rising costs of production relative to market-prices are causing much concern. Unable to pass on higher costs, growers have endeavoured to overcome the problem through greater mechanization. There has been wide-scale adoption of bulk-handling, more efficient and speedier spraying by means of air-blast units, less pruning, and increased chemical-thinning.

Harvesting remains an operation which so far cannot be mechanized. Therefore growers in increasing number are making provision to eliminate in new plantings some of the costs of harvesting. This is by close-planting of trees on dwarfing-rootstocks. The smaller trees will be handled without recourse to costly labour and ladder-work.

In the Batlow, Forbes, New England, Orange and Bilpin districts during the past five years many acres of trees have been close-planted, with per acre tree-density about twice that of the former standard-planting distances.

Container-Trends for Pome Fruit

Use of traypack-cartons continued to increase at the expense of wooden cases. Between 50 and 60 per cent of the New South Wales apple crop is now traypacked for local markets, and almost 100 per cent for export. A lightweight packing material, a honeycomb-like series of cells, was introduced by commerce during the year. It gives excellent protection to the fruit, similar to ordinary cell-packs.

Pome Fruit Variety-Trends

Granny Smith, Jonathan and Delicious continue to be the most-planted apples. In the later districts, Crofton and Bonser (a late-storing chance-seedling from Batlow), have also become popular, in the past two years. There have also been some small plantings of Golden Delicious apple, one that should become better known to the public.

Very few pears have been planted in recent years, and only Packham, Williams and Beurre Bosc.

Pome Fruit Cool-Storage Trends

Cool-storage space in New South Wales enormously increased over the past decade, and now amounts to 2,500,000 cases. Of this total, 2,134,000 case-space is in the late districts—Orange, New England, and Batlow—and roundly equivalent to three-quarters of the total production of these areas.

Use of diphenylamine (DPA) for superficial-scald control in apples and pears was approved by Health authorities during the year. In the storage districts much publicity was given to the several methods of treatment. A large proportion of the Granny Smith crop was DPA-treated by either dipping or wrapping. These methods will quickly supersede the oiled-wrap method of prevention.

Use of "Controlled Atmosphere" (CA) storage received a boost this year, from a Batlow demonstration of the value of "Tectrol" units designed for quick adjustment of the desired storage atmospheres. Following the very favourable out-turn of the demonstration fruit, Batlow Packing House Co-operative has installed units for two new coolrooms; a capacity 30,000 cases. A unit has been installed also at Orange. Provided the

primary cool storage rules are adhered to, CA storage will do a lot to eliminate the unfavourable public impression which has built up in recent years because of poor quality air stored fruit held until late in the year.

Effects of Pome Fruit Export—pessimism

Through virtual collapse of the United Kingdom and European markets in 1966 there has been very little interest this year by importers overseas in buying forward. As a result the exporters here dropped their prices to growers by 30 to 50 cents per case. This created grower dissatisfaction and quantities of fruit which could have been for export were diverted to local markets. Neither the pessimism regarding overseas markets nor optimism in regard to home markets was in due course justified.

Prices on the overseas markets have never been better whilst the prices on the Sydney markets for Granny Smiths, the only export variety of consequence, have been very low.

Because of the early pessimism regarding overseas prospects, on the part of all concerned, the N.S.W. Forecasting Committee for Export in December, 1966, considered it unwise to be unduly optimistic as to supplies from N.S.W. Consequently it submitted to the Australian Apple and Pear Board the comparatively low figures of 145,000 cases of apples and 15,000 cases of pears, for all destinations. Happily, these figures will be slightly exceeded. Most States were far too optimistic in their early estimates, with consequent disruption of shipping services.

STONE FRUIT INDUSTRY TRENDS

Plantings and Record Production Trends

Areas planted and production of most varieties of stone fruit have steadily expanded. This has been so over the past few years. From 20,086 acres of stone fruits in N.S.W. in 1961, the total has increased to 23,824 acres in 1965. Commonwealth Statistician figures show an increase of the farm value of stone fruit produced in N.S.W. from \$4,935,600 in 1954-55 to \$7,773,000 in 1965-66.

Production of stone fruits in 1966-67 was high. Records were established for canning peaches and prunes. Figures for other stone fruits are not yet available but it is likely that production of dessert peaches, apricots, and plums also were higher than ever.

Some 8,894 tons of apricots from irrigation areas went to canneries and a further 42,633 cases were consigned to market. The total of 9,371 tons almost equalled the record tonnage of 9,472 (1964-65). Also, Kurrajong area marketed a good crop of early apricots.

A record 21,186 tons of canning peaches were harvested in the M.I.A., as against 19,968 tons in 1965-66. The greater production is mainly due to new plantings now at bearing age. Production average per acre in 1966-67 was 5.9 tons; somewhat lower than the norm of recent years. Although the area of bearing trees has increased, the M.I.A. census indicates that total bearing area has reached its peak and will begin to decline. It will take at least five years to reverse this trend with increased plantings.

The dessert peach crop was good. Most of the fruit marketed was of high quality. Brown rot and transit rot caused consignment losses in wet periods. Prices remained satisfactory for quality fruit. Inferior lines were difficult to clear.

Supplies of plums to the market were good throughout the season. Prices remained satisfactory for quality fruit.

The prune crop was a record; over 5,000 tons of prunes (dried weight). A quota of 45 per cent has been fixed for home consumption sales. Fruit size and quality were good throughout the season. There has been a marked trend towards bulk handling of prunes, and a change to parallel-flow dehydrators. The latter reduce drying time appreciably by comparison with the conventional counter-flow dehydrators.

Cherry crops at Young were affected by the previous year's drought and at Orange by hail. Also, the fruit in all districts except the northern tablelands was damaged by wet weather at harvesting. Early maturing cherries from Griffith and Lakesland districts demanded high prices. Good prices were received for quality fruit throughout the season, especially the northern tablelands consignments.

STRAWBERRY INDUSTRY TRENDS

The acreage planted to strawberries continues to increase and good crops of quality berries are being produced. Release of the new varieties and of virus-free planting material have renewed interest in strawberry production in many parts of the State. This is especially apparent on the central coast near Sydney and Gosford.

TRENDS IN MISCELLANEOUS FRUIT AND NUT INDUSTRY

Numerous small plantings of olives are raising the production total. Production of almonds and other nuts is declining. Persimmons are receiving some attention at Gosford and Griffith and in the Windsor district. There has been no extension of fig plantings in recent years.

TROPICAL FRUIT INDUSTRY TRENDS

Banana Production Trends

The bulk of the crop is handled by the Banana Growers' Federation transport system and figures from the Federation show that 3,726,831 packages were transported. Of these, 638,534 were cartons (about 7/10ths of a bushel) packed in hands and 3,124,297 were bushel cases packed in singles. Fruit sent to Brisbane by road amounted to 39,016 bushels, and the amount sent south was 3,532,255 bushels, giving a total transportation figure of 3,571,271 bushels. Local sales, and disposals through other avenues, are estimated at 150,000 bushels. In all, the 1966-67 total production of bananas in N.S.W. was thus about 3,721,271 bushels.

The downward trend in production has continued, the reduction this year being about 128,800 bushels. Losses in some areas from cyclones and other adverse weather conditions, and the general trend to eradicate unprofitable plantations, are contributing factors.

Banana Planting Trends

The acreage under bananas in N.S.W. is 23,451; 274 acres less than in 1965-66. New plantings amounted to 1,540 acres, in part offsetting the 1,814 acres destroyed for various reasons. The net decrease is less than that in 1965-66 but steady decline continued. The trend is a result of growers' removal of plantings—as soon as production begins to lessen—to plant replacements which will consolidate their high-production areas. Their objective is a higher proportion of fruit harvested outside the summer peak-production period. It is of interest that on the Richmond more than twice as many acres were destroyed (642) as were planted (299). The situation was similar in the Nambucca River district. There the figures were 204 acres destroyed and 110 planted. In other districts the plantings either equalled or were greater than the destructions.

About 90 per cent of the plantings in N.S.W. are of the Williams variety, but in the near coastal areas of the Richmond and Brunswick districts there is a trend to increase Cavendish plantings.

The number of commercial growers continued to decrease, decreasing from 3,041 in 1965-66 to 2,972 in 1966-67. It reflects movement of growers from poor plantations to other employment.

Use of Cartons for Bananas

Analyses of production and packaging indicate steady increase in the use of cartons. Percentage of cartons in the total of packages marketed was 17.6 per cent in 1966-67, 2½ per cent higher than in 1965-66. Districts differ in their acceptance of the carton method. Highest acceptance rate is in the Coff's Harbour area. There 24 per cent of the packages were fibreboard cartons.

Packing Houses for Bananas

Two central-packing houses are now in full operation; Coff's Harbour and Mullumbimby. Keen interest is showing in at least one other northern district. The two in operation have standardized their pack to 30 lb net weight, packed in hands, and are also marketing in three quality-graded lines.

New Market for Bananas—the M.I.A.

In November, 1966, bananas were introduced legally into the M.I.A. for the first time since quarantine restrictions were applied in that area to bananas. The fruit is packed in hands, in wooden cases (18 in x 14½ in x 8½ in) and gets a 3-minute dip in dimethoate at 0.03 per cent concentration as a fruit-fly disinfestation precaution before entering the M.I.A.

Between November, 1966, and the end of June, 1967, 14,377 cases have been admitted for sale in the M.I.A. In June, 1967, the commodity-treatment was transferred from Narrandera to the despatch-point at Coff's Harbour. Entry and release after ripening are supervised by fruit inspectors.

Banana Nematode Control

Hot water heat-treatment units are now operating in the Tweed and Coff's Harbour districts, and a third is ready at Broadwater on the Richmond for use in the 1967 planting season. On the Tweed and at Broadwater the C.S.R. Co. Ltd have co-operated with the Banana Growers Federation and the Department in making facilities available for these projects.

TRENDS IN OTHER TROPICAL FRUITS

There is increased acreage of pineapples, passionfruit, avocados and macadamia nuts in the Tweed, Brunswick, and Richmond areas. The notable increases have been 57 acres of pineapples and 35 acres of macadamias. The macadamia plantings in the increase comprise grafted trees from selected parents. Interest in this crop is such that a further increase in plantings can be anticipated in the Richmond and Brunswick River districts.

Processors are increasingly interested in pineapple and passionfruit for juice. The interest stems from consumer-demand for juice-nectars rather than for straight juice. Pineapple and passionfruit provide ideal, acid juice-base for nectar-processing. Ballina cannery has extended its premises to cater for expected increased production of pineapples, passionfruit, and tomatoes.

Regulatory Services by Division of Horticulture

COUNTRY INSPECTIONS

Fruit Fly Control

Whole-town treatment-schemes continued their success and more towns are participating. Every major town in the central west, which was previously a fruit fly problem-centre, has now joined in the scheme. Except at Richmond and Windsor, where wet weather interfered with baiting, fruit fly was not a problem in towns applying whole-town treatments. In many untreated towns fruit fly was a severe problem this year.

A difficulty now is the inability of householders to get small packages of malathion W.P. and protein hydrolysate. Many have expressed concern at suppliers' withholding of these items from shops. Alternative controls, more remunerative for suppliers, are not always practical for a home-gardener.

Five adult flies were trapped in Griffith and one in Leeton. This affects export of citrus from the M.I.A. to New Zealand, and post-harvest EDB fumigation is obligatory in the ensuing season.

The San Jose Scale Problem

This scale is a continuing problem. Some districts report improvement following special campaigns. The campaigns included destruction of seedling fruit-trees on roadsides and along fence lines, etc.

Red Scale Effect on Export

Recent advice from New Zealand in respect to red scale on citrus export-fruit again drew attention to the need for continued action to improve the grower-control of this pest. Citrus growers have to be aware of the serious view taken in certain markets, of even a few live scale-insects.

Fruit Presentation and Maturity

Fruit-presentation and maturity received constant attention. Fewer immature grapes and citrus were consigned to markets. City Markets inspectors report improved general standard of presentation of most fruits, in part due to use of new containers. The last stronghold in New South Wales of the dump-case for citrus has been breached; cartons and the "Bruce Box", the latter mainly for export consignments, have almost eliminated use of the dump-case in the Lower Murray districts. County of Cumberland apricot growers collaborated to set higher standards in grading and presentation. Their results were subject of favourable comment by market agents and retailers.

Standards in Registered Packing Houses

All registered export-establishments (citrus) were inspected. Several registrations were cancelled. In other instances the packing sheds were brought to a higher standard. There are now five registered (or "registration pending") EDB chambers in New South Wales, two more than a year ago.

Rice Quarantine

Discussions on quarantine were held with the Rice Industry Co-ordination Committee. The freedom from disease in New South Wales rice-growing is of great value to the industry. Much of the expansion of this crop is in areas not protected by quarantine. Progress has been made in defining the area and nature of protection.

Tomato Grading

New tomato-grading regulations were gazetted after discussions with the Queensland Department of Primary Industries and with representatives of the growers, and the wholesale and retail trade. The two States now have similar legislation and uniform grade-standards for tomatoes.

Inter-State Quarantine

Action has been taken to protect New South Wales lucerne crops from possible introduction of bacterial wilt from Victoria, and is in train against introduction of onion smut from South Australia.

SYDNEY CITY MARKETS INSPECTIONS

Fruit Grading and Presentation

The standard of grading was quite good. Some lines of pome fruit were reduced in grade mainly because of hail damage, limb rub and sunscald. Occasional lines of citrus, mainly from New South Wales, were reduced in grade. Interstate citrus was generally well-graded and set a high standard.

The overall standard of presentation has further improved with the increased use of attractively printed cartons for almost all types of fruit.

Infested Fruit

The quantity of consigned fruit affected by Queensland fruit fly was relatively small; 121 bushels destroyed. Only 43 bushels had to be destroyed for codlin moth infestation.

Supplies: Sources and Quality

Apples. Supplies of the previous season's fruit, towards the end of 1966 were light. Quality was only fair but they cleared readily. Quality of new season's fruit was only fair. From some districts hail-damage together with dimple-bug damage and sunburn were prevalent.

Pears. The main source was Victoria. These were mostly export-culls, marketed as "Good" and generally graded unsatisfactorily. The rest came from New South Wales districts and in general were well-graded and presented.

Oranges. The fruit was predominantly from Murray Valley districts and set a high standard of presentation, grading and quality. Queensland growers followed suit. New South Wales growers in coastal districts in particular showed less interest in improving their pack.

Eleven consignments of Valencia's, 299 bushels, but only one consignment of Navel's were withheld from sale due to immaturity. Three consignments of Valencia's, 176 bushels, were found to be dry.

Grapefruit. South Australia, Queensland, and Narromine were the main sources. Quality was generally good. Poorly presented lines of grapefruit have no chance at any price.

Lemons. Supplies were generally up to market demand. During short supply in December prices were high and as a result some supplies came from West Australia. Development of blue mould in local lemons and in Meyers from Queensland cause re-packing of numerous consignments.

Mandarins. There were only moderate supplies from local districts. Quality was from satisfactory to very good. Queensland sources sent very attractive lines of Ellendales and Glens.

Grapes. Supplies started in mid-December from Queensland, New South Wales and Victorian districts continued to supply until the end of May. All early consignments were tested for maturity and, as a result, 37 consignments (709 cases) were seized and destroyed.

Peaches. The fruit from early coastal-districts was high quality. A small proportion was badly grown and poorly presented. Inland peaches were in adequate supply. Peaches from all districts were later than normal in maturing.

Apricots. Supplies were only moderate. Quality from Kurrajong was affected by weather-damage and brown rot. Inland apricots were disappointing and many had to be re-packed. Murray Valley consignments were generally high quality and sold well.

Cherries. Hail and rain at harvesting seriously damaged the crop, particularly from Orange. Much of the fruit marketed was of inferior quality.

Nectarines. Supplies were light. Some were very high quality and some were affected by breakdown.

Plums. Supplies were only moderate. Large size, well-graded fruit sold freely. Small and inferior-quality lines were difficult to clear.

Strawberries. These were available throughout the year from different sources. The New Zealand packs were of high standard. Local and interstate growers have improved their packs to meet the competition.

Pineapples. The supplies, moderate throughout the season, were generally in good condition.

Bananas. During the winter months the supply was light and the quality was poor—particularly in the sixes and sevens grades. These grades contained a percentage of undersized fruits. Grading was better in the summer months but has since declined to poor quality and under-sized fruits in the small-grades.

Tomatoes. Supplies were heavy during most of the year. Glut conditions prevailed often. Queensland was the main source during winter, followed by northern New South Wales, local glasshouse and the metropolitan field crops. Because quality was extremely variable a lot of regulatory action was necessary. Local metropolitan growers were the worst offenders—particularly with regard to correct branding and to obliteration of old brands on cases.

Potatoes. Potato crops from all areas have been good. A few consignments were degraded for undersize. Potato moth was very evident but not in plague proportions. Of about 1,500,000 bags received through Perry Park and Alexandria, 54,697 bags contravened the Grading Regulations.

Vegetables, General. Supply of vegetables in the markets has been constant and of high quality. Improved presentation through use of better containers and through washing of root vegetables was noted. Castaway certificates totalling 932 were issued for 10,959 packages of unsound vegetables.

PLANTS, FRUIT AND VEGETABLES TO OTHER STATES

Consignments of Plants

Inspections were made at various nurseries in the County of Cumberland and at Export and Import Branch, Day Street, arising from consignment of plants interstate. Issues of the "Certificate of Freedom from Disease" were involved, in 418 visits, for 46,332 plants, and the "Certificate of Treatment", in 642 visits, for 110,791 plants.

Fruit and Vegetable Consignments

During the year 6,473 cases of fruit and 16,436 packages of vegetables were inspected, subject to issue of certificates for interstate consignment—mainly to Tasmania.

EXPORT INSPECTIONS

Fresh fruit and vegetables, seeds, rice, wheat, flour, etc., submitted for export were examined on behalf of the Commonwealth Department of Primary Industry under the provisions of the Commerce (Trade Descriptions) Act.

Export Pome Fruit

Apples. A total of 163,175 bushel cases and cartons were shipped from the port of Sydney; 9,000 bushels more than in the previous year. Most was to the United Kingdom and Europe, the rest to south-east Asia and Pacific Island ports. Rejects totalled 9,929 bushels, a higher percentage than last year. Causes of rejection were bruising, sunburn, Codlin moth, San Jose scale, black spot, size variation, under-weight cartons, over-maturity and breakdown. The supply was mostly from the M.I.A. and northern tablelands. Most (152,860 bushels) were packed in cartons.

Pears. The quantity shipped was 13,302 cases; 10,000 less than in the previous year. Most were Fancy Grade and were shipped to Pacific Islands and south-east Asia destinations. There were small consignments to the United Kingdom. Rejects totalled 1,085 cases; mainly for excessive pre-cooling temperatures, or overmaturity, breakdown, or undersize.

Export Citrus

The total of New South Wales-grown citrus exported through various ports approximated 334,000 bushels.

Oranges. There was a substantial increase; 102,530 bushels shipped as against 47,144 in the previous year. The main source was the M.I.A. Destinations were mainly south-east Asia and Pacific Island ports. There were two experimental lots; 6,159 bushels of "picked" Valencias (as against "clipped"), to France; and 4,144 4/5-bushel cartons to Asian ports. Each of these shipments were received favourably at the destinations.

Mandarins. Only 2,300 bushels were shipped, 50 per cent less than in the previous season. Practically all went to Canada. Some 336 bushels were rejected for overmaturity or albedo breakdown.

Grapefruit. 1,179 bushels were shipped, to Pacific Island destinations.

Lemons. 808 bushels were shipped to the Pacific Islands.

Other Export Fruit and Vegetables

Grapes. The quantity shipped was slightly less than in the previous year and totalled 11,515 cases. Most consignments were from the M.I.A. and consigned to Pacific Island destinations—in many instances by air freight.

Stone Fruit. 1,140 cases of apricots, 5,080 cases of plums, 5,665 cases of peaches, and 1,781 cases of cherries were shipped to Pacific Island destinations.

Miscellaneous Fruits. These were mainly Mangoes, Custard Apples, Avocados, and Bananas. They totalled 1,479 cases and mainly were consigned to Pacific Islands.

Tomatoes. The total tomatoes shipped was 14,879 cases, 6,000 more than in the previous year. The increase was due mainly to purchases by American armed forces in the Philippines.

Other Vegetables. 108,156 packages of vegetables were shipped to overseas destinations, mainly to Pacific Islands. There were numerous rejections. Mostly the rejections were for soil on root vegetables, or for bad packaging.

Cereal Exports

Wheat in Bulk. Shipments of wheat did not start until the new season harvest was available in mid-December, 1966. To 30th June, 1967, in the ports of Sydney and Newcastle, 126 ships have been surveyed and loading permits were refused for 24 of these. The 24 required fumigating, spraying, and cleaning. Wheat loaded in Sydney and Newcastle has so far totalled 1,448,197 tons, and 20,211 tons have been rejected. Since shipments commenced, in December, inspections have been constant throughout almost every day of the week.

Bagged Wheat. Bagged wheat, usually in small parcels, was inspected at the Export and Import Branch or shipside. The total was 1,854 tons.

Flour. A total of 109,687 tons of flour was shipped; 41,000 tons more than in the same period of the previous year. Destinations in the main were Ceylon, India, Pacific Islands, southeast Asia, the United Kingdom, Pt Louis, and Aden. Rejections were 2,038 bags, for being wet, and 25 bags for beetle infestation. Bags and branding were satisfactory.

Rice. The 75,777 tons of rice exported from the port of Sydney in the last twelve months is 4,000 tons less than for the previous year. The importing-countries in the main were New Guinea, Pacific Islands and United Kingdom. Rejections totalled 9,300 bags, due to larvae on bags. Bags and branding have been of satisfactory standard.

Export of Plants, Seed, Cut Flowers

Plants. International Phytosanitary Certificates were issued for 545 consignments, totalling 10,072 plants. Inspections were done at the Metropolitan Nurseries and the Export and Import Branch.

Seed. Large quantities of seeds were exported. These included 5,675 bags of pasture seed, 987 bags of cereal seed, 2,746 bags of bird-seed and 52 bags of tree-seed. Flower and vegetable seeds, mostly in dry-conditioned packs, totalled 2,222 consignments.

Cut Flowers. 1,610 cartons of cut flowers for overseas destinations were inspected, usually at Kingsford Smith airport.

IMPORT INSPECTIONS

Importation of plants and plant products from overseas were examined for the Commonwealth in accordance with the provisions of the Quarantine Act.

Projected New Plant Quarantine Station

Establishment of a Plant Quarantine Station at Rydalmere is on the way. The site has been fenced and tenders called, on behalf of the Commonwealth Department of Health, for erection of a glasshouse and two shade houses. This station will eliminate the need to hire facilities for quarantine of nursery stock. As the principal plant quarantine station in New South Wales, its location adjacent to the Division of Science Services will enable most efficient implementation of post-entry quarantine requirements.

Imported Nursery Stock

The quantity imported was considerably less than in 1965-66. Some 9,692 plants were held under the Regulations. These included 3,985 orchids, 1,701 ornamentals, 905 succulents and cacti, 192 aquatic plants, 1,057 bulbs and rhizomes, 1,760 rose budding eyes, and 92 sugar cane cuttings.

Incidence of pest and disease has been very slight. Some mealy bug, scale, aphid and mite infestations were detected; requiring fumigation with methyl bromide before the items were released to quarantine nurseries. Post-entry inspections of plants disclosed disease-development in a few and these were destroyed.

Parcel Post Inspections

Examination of all goods and articles arriving from overseas and subject to Quarantine Regulations continued through the year at Sydney Mail Exchange. The recorded number of packages was 10,435. Of these, 1,485 were detained for further examination, treatment or destruction.

Ship, Waterfront, and Aircraft Inspections

Air craft Inspection, Mascot. The number of flights from overseas into Kingsford Smith airport totalled 5,020 and the number of passengers and crew landed was 317,563, comparable with the previous year. Prohibited items (mainly fruit) seized from passengers or crew amounted to about 3,000 lb. Items held for further action totalled 587.

There were 1,259 inspections of cargo. The cargo included 22,466 cartons of berry fruit from New Zealand, and imports of cut flowers, etc.

Aircraft Inspection, Richmond. Quarantine inspection of 274 planes was done at Richmond RAAF Station. Some 2,080,000 lb of cargo was carried on these planes. This was mainly military equipment returning from south Asia. Soil contamination was the main reason for the quarantine actions taken. Also, two cargoes were infested with ants and numerous items were quarantined for wood-boring insects.

Passenger Ships. In all, 303 passenger ships were attended on arrival for inspection of passengers' goods and articles brought to attention by Customs. Considerable quantities of prohibited goods were detained for treatment or destruction.

Naval Vessels. Naval vessels transporting servicemen from overseas postings have been given quarantine inspections both after arrival and during transit. Service personnel returning from Vietnam on H.A.M.S. *Sydney* in May, 1967, were joined at sea by customs and quarantine officers transported by helicopter from Brisbane when the vessel was off that port. This enabled quarantine and customs clearances to be effected prior to arrival in Sydney.

Cases and Packing. Regular inspection at wharves, of cargo not requiring a Quarantine Permit, included all cases, packing, bales, etc. The main objective was detection of wood-boring insects.

Dunnage. Large quantities of dunnage were landed from overseas ships. The usual large percentage was found to be infested. All dunnage was either fumigated under supervision or destroyed by burning. Notable amongst the detections in dunnage were several instances of severe infestation by Carpenter ants.

Personal Effects. There were 1,612 appointments made for inspection of personal effects. These resulted in 25,657 articles passed and 1,239 quarantined—usually for fumigation.

Ships' Cargoes. Regular inspections of all items of ships' cargo requiring quarantine permits were carried out during the year. One of the most time-consuming was inspection of motor vehicles. These totalled 14,638 vehicles; 2,156 were not new and 41 per cent required steam-cleaning for removal of soil.

Other items inspected were: regular shipments of beans (restricted); pasture seed, often contaminated by weed seed and insects; dates, figs, nuts, coffee, cocoa, and copra, etc. Bamboo and other wooden articles often were infested with borers. Cases of cashew nuts from India were almost 100 per cent infested. Large quantities of wooden articles from southeast Asia, including toys, baskets, artifacts, musical instruments, etc., were brought to Export and Import Branch for detailed inspection.

As a result of partial, local-crop failure two shipments of broom millet were imported. To render the unthreshed seed non-viable, and as a precaution against insect infestation, each lot was heat-treated. Among other activities, for Customs, is the inspection of seeds of narcotics and their deactivating and cleaning. The main one of these in Blue Mau (Opium Poppy).

Timber. The total of timber imported into the Port of Sydney and Port Kembla was 223,060,000 super. feet; $2\frac{1}{2}$ per cent less than in 1965-66. Approximately, 2,784,186 super. feet was quarantined and treated because of wood-boring insects; a much higher percentage than last year. One reason was the need to treat approximately 250,000 super. feet of Ramin from Malaysia. Log importations were less this year, but there was 25 per cent increase in infestation. Sources of supply were mainly Borneo, Indonesia, Malaysia, Baltic countries, New Zealand, and North and South America.

DIVISION OF ANIMAL INDUSTRY

General

STAFF

Administrative Professional Staff Changes

Former Board of Tick Control Chairman Mr J. N. Henry was promoted to Deputy Chief of the Division when the former Deputy Chief Mr N. K. Golding was appointed to Central Administration as Chief of Research Stations Branch. Mr A. N. A. Harris, former District Veterinary Officer, succeeded Mr Henry as Chairman of the Board of Tick Control. Other administrative changes included the appointment of Mr G. L. Slennett to the position of Principal Livestock Officer (Poultry), Mr D. A. Dickinson to Assistant Principal Veterinary Officer (Exotic Diseases), Mr D. R. Mumford to Assistant Principal Veterinary Officer (Disease Control), and Mr H. E. R. Beattie to Special Veterinary Research Officer (Mastitis).

Professional Staff—Vacancies

At 30th June, 1967, there was no vacant position in the Veterinary Research Officer, Livestock Research Officer, nor Livestock Officer (Apiculture) establishments, but two vacancies for Veterinary Officers, twenty-three for Veterinary Inspectors, three for Livestock Officers (Sheep and Wool), one for a Livestock Officer (Beef Cattle), four for Livestock Officers (Pigs), and two for Livestock Officers (Poultry).

Advanced University Degrees

The following officers were awarded the degree Ph.D.: Dr P. J. Mylrea, Special Veterinary Research Officer (Thesis: "Factors affecting the health of calves with particular reference to the digestive tract", University of Sydney); Dr I. K. Hotson, Special Veterinary Research Officer (Thesis: "Studies on infection with *Haemonchus* spp. and *Ostertagia* spp. (Nematoda; *Trichostrongylidae*) in cattle and sheep", University of Sydney); and Dr P. J. Healy, Veterinary Research Officer (Thesis: "Pathogenesis of *Macrozamia* poisoning with special reference to the biochemical disturbance leading to hepatic necrosis and accumulation of lipid in the liver", University of Sydney).

Twelve other officers were at the end of the year pursuing studies towards higher degrees: eleven for the Ph.D. and one for an M.Sc. degree. One officer returned during the year, after completing Ph.D. studies, and subsequently submitted his thesis for examination by University authorities.

Officers Overseas

Eleven professional officers were overseas for all or part of the year, for special studies or on special assignments. The details are as follow:

Mr C. W. Brett (Livestock Officer, Beef Cattle), studying beef cattle production methods in the U.S.A., on a Rotary International Scholarship.

Mr C. G. Cargill (Veterinary Inspector), studying veterinary pathology for an M.Sc. degree at University of Alabama, U.S.A., on a Rotary International Scholarship.

Mr P. D. Claxton (Veterinary Research Officer), studying at the University of London for a Diploma of Bacteriology, on Australian Wool Board Scholarship.

Mr A. A. Clemson (Principal Livestock Officer, Apiculture), visited U.K., U.S.A., Canada, and Europe to study the honey production and quarantine procedures regarding queen bees; and to attend the International Honey Convention at Vienna and the International Apicultural Congress at Maryland, U.S.A.

Mr D. A. Dickinson (Assistant Principal Veterinary Officer, Exotic Diseases), visited the U.K. and Italy to study the eradication of foot and mouth disease and the control of other diseases, and to attend the FAO Sheep Diseases Conference in Rome.

Mr J. F. Dillon (Livestock Research Officer), studying poultry science at the University of British Columbia, Canada, for a Ph.D. degree, on a Commonwealth Scholarship.

Dr R. B. Dun (Director of Animal Production Research), visited New Zealand at the invitation of the New Zealand Wool Board to deliver lectures and inspect sheep research centres.

Dr J. M. Holder (Supervisor of Research, Wollongbar), returned during the year after attending the International Grassland Conference at Helsinki and the Animal Production Society Conference at Edinburgh and visiting research centres in the U.K., U.S.A., Canada, Europe, and New Zealand.

Mr G. L. Lee (Livestock Research Officer), studying bee genetics at the University of California, U.S.A., for a Ph.D. degree.

Mr J. Nolan (Research Officer), studying insecticide chemistry at Cornell University, U.S.A., for a Ph.D. degree.

Mr B. R. Wilson (Livestock Research Officer), visited pig research centres in New Zealand under the auspices of the Australian Dairy Board.

Retirements

Assistant Principal Veterinary Research Officer Mr S. P. Hebden and District Livestock Officer (Sheep and Wool) Mr E. S. May retired during the year.

Death

The death of Mr D. J. McRae, District Livestock Officer (Pigs), is recorded with regret.

A DISTRICT VETERINARY LABORATORY FOR NORTH COAST

A site for a District Veterinary Laboratory to serve the north coast was selected at Wollongbar Agricultural Research Station. Plans were completed and a contract was let for the construction. The laboratory should be operating by early 1968.

Livestock Health—Field Activities

REGULATORY DISEASE CONTROL

Anthrax

Twenty outbreaks occurred, comparable with the number of outbreaks in the preceding year and somewhat less than the norm for earlier years. All outbreaks were in the recognized anthrax belt. Most mortalities were comparatively light but 120 sheep died from the disease on each of two holdings.

The reduced incidence was partly due to drought conditions and partly to the policy of extending the issue of inoculators' licences. Arising from this policy, the number of stock vaccinated annually has increased significantly. Stock vaccinated totalled 126,697, on 132 properties. The previous year's figures were 78,345 vaccinations on 92 holdings.

The following table shows the distribution of outbreaks:

Administrative District	No. of Outbreaks	No. of Stock Quarantined				No. of Deaths			
		Cattle	Sheep	Pigs	Horses	Cattle	Sheep	Pigs	Horses
South	10	665	4,377	74	..	14	141	7	..
West	10	9	8,874	231	1	2	221	30	..
Total	20	764	13,251	305	1	16	362	37	..

Brucellosis (Pigs)

One infected property was detected and quarantined. The diagnosis followed investigations into a series of abortions. A test of the breeding stock, 110 head, showed 21 positive and 6 doubtful. After the positive and doubtful reactors had been slaughtered and other breeding stock consigned for slaughter as well, a retest showed three reactors and six doubtful reactors out of 36.

Suspicion existed that the infection may have been introduced through purchased boars. But, when two holdings from which the boars had been obtained were tested, all reactions were negative and the source of the disease remained undetermined.

The voluntary brucellosis-free herd scheme was maintained. Fifteen herds were accredited.

Footrot (Sheep)

In general, footrot incidence was light. In the most severe incidence reported, there was 75 per cent clinical cases in 700 Merino ewes which arrived at an abattoir.

In the Armidale Quarantine Area (4,000 owners and 000,000 sheep) there were 10 known-infected properties at the start of the year and during the year a further 11 outbreaks were reported. Eradication measures were deemed successful on 12 holdings, leaving nine infected at the end of the year. Of the 12 where eradication was deemed successful, six were dealt with by treatment of clinically affected animals and recognized carriers, five by treatment together with disposal of obstinate cases for slaughter, and in the other one all infected and in-contact sheep were sent for slaughter. Of the 10 known-infected holdings at the start of the year, seven were still infected at the end of the year. Three of the fresh outbreaks detected were due to the introduction of infected sheep from the southwest of the State. For much of the year, weather in the area was not conducive to spread of the disease.

Johne's Disease

No outbreak of Johne's disease was detected. Quarantine was maintained on eight holdings where the disease had been previously diagnosed. Five of these were released during the year.

A property which has been in and out of quarantine for this disease for about 20 years the whole herd received the double intradermal test, using avian tuberculin. The complement fixation test was performed also on serum from each of the herd. Of the 281 head, one was positive and three were doubtful reactors to the intradermal test, while there were five positive and 11 doubtful reactors to the complement fixation test and 21 serum samples showed slight reactions. The correlation between the two tests was poor. The six positive reactors were sent for slaughter, as were six doubtful reactors born before the clinical cases of the disease were destroyed. The herd was released from quarantine.

Observations on correlation between results of the complement-fixation test and the recovery of the causal organism continued in a herd in which Johne's disease occurred some years ago. Between 1962 and 1967: 515 animals have been examined serologically at the Glenfield Veterinary Research Station. Cultural examination was attempted on tissue from 449 animals. The organism was recovered from two animals. One of these was negative and one was a doubtful reactor to the complement fixation test. Apart from those two, eight animals gave positive and 13 gave doubtful complement-fixation reactions. These 21 animals were negative on culture. Again the correlation between complement-fixation test and recovery of causal organism was poor.

Parasites External (Sheep)

The following table shows the numbers of holdings and sheep quarantined because of sheep lice (*Damalinia ovis*) and sheep ked (*Melophagus ovinus*):

Administration Area	Lice Infestation		Ked Infestation		Lice and Ked	
	Holdings	Sheep	Holdings	Sheep	Holdings	Sheep
Central	15	42,193	..	..	..	..
Central West	134	126,107	18	14,471	1	1,300
Cumberland	6	2,440	1	20	..	..
Far West	38	86,486	..	..	..	..
North	165	239,682	35	58,514	8	9,926
North West	75	98,342	..	..	..	..
South	110	135,405	1	1,665	..	..
South East	69	88,812	33	45,789	9	6,029
South West	162	139,574	..	..	..	..
West	10	38,733	..	..	..	..
Totals	855	997,774	88	120,459	18	17,255

Pleuropneumonia Contagiosa (Cattle)

No outbreak occurred. Serum samples from two bulls as part of a beef cattle brucellosis-survey reacted positive to the complement-fixation test. These animals had come from and been vaccinated in Queensland not long before the samples were taken.

Some 1961 other complement-fixation tests for this disease were done on cattle to meet the needs for export and entry into two protected areas in New South Wales but no reactions were detected. Surveillance over Queensland cattle was maintained.

Pullorum Disease (Poultry)

Sixty outbreaks of pullorum disease in chickens were diagnosed. Mortality rates were from one to 10 per cent. A big proportion of the outbreaks originated from chickens from three large hatcheries.

Testing was continued under both the voluntary accredited-flock scheme and the Stock Diseases Act regulations which require annual testing of all flocks from which chickens under three weeks of age, or hatching eggs, are sold.

Pullorum Testing

The following is a summary of testing done under both schemes:

Scheme	Flocks	Birds	Positive	Positive	Doubtful	Doubtful
				%		%
Accredited flocks (Sydney Area)	90	515,079	1,883	0.36	1,973	0.38
Accredited flocks (Country Areas) ..	18	102,457	34	0.03	226	0.22
Total accredited ..	108	617,516	1,917	0.31	2,199	0.35
Compulsory testing (Sydney Area)	53	59,040	511	0.86	528	0.89
Compulsory testing (Country Areas) ..	45	86,783	849	0.96	418	0.47
Total compulsory ..	98	145,823	1,360	0.93	946	0.65

A significant number of reactors was detected in each of 12 flocks previously regarded as free or almost free of the disease. In two of the flocks, for many years accredited as pullorum-free, up to 50 per cent of birds in some pens reacted.

A possible explanation for the reactors found in many of these flocks is failure of the previously-used antigen to produce reactions in infected birds. Two locally produced antigens have been in use. Studies showed considerable differences in the number and intensity of reactions given by the two antigens when used on the same birds. Trials were initiated to compare the local antigens with two imported antigens. Suitable strains were selected also from field isolates, towards developing further antigens for use in field testing. The occurrence of variant, intermediate and standard strains of *Salmonella pullorum* were studied.

The significance of doubtful reactions to the rapid whole-blood test was investigated. These have constituted an interpretation problem. From one flock *Salmonella typhimurium* was isolated and shown to be able to produce positive reactions to antigens used in the pullorum test. *Salmonella pullorum* was also isolated from doubtful and negative reactors to the rapid test, indicating lack of sensitivity of the antigen used.

Swine Fever

No outbreak occurred. Suggestive brain lesions were detected in one of three piglets submitted to the Glenfield Veterinary Research Station. But blood samples from litter-mates of the three piglets were negative to the gel-diffusion precipitin test, and a pig which received transmission material from the affected pig remained healthy.

A few gel-diffusion precipitin tests were done at Glenfield. The conventional pancreatic-tissue antigen from infected pigs was replaced during the year by an antigen from cell cultures affected with the virus of bovine virus-diarrhoea.

Trichomoniasis (Cattle)

No outbreak was detected, for the second consecutive year. A property in quarantine when the year started was released.

Tuberculosis (Cattle)

Quarantine-Area Scheme. The programme of compulsory testing of all cattle within Quarantine Areas, initiated in 1960, was continued. At the start of the year there were 70 Areas. Five more were added this year. All are in coastal districts. Dairy cattle predominate in most.

Testing was done in 73 Areas. Cattle tested totalled 761,677, a significant increase on the previous year's 673,522. Compared to the previous year, the reactor-total and reactor-percentage each increased. The reactor-total was nearly twice the previous year's; 2,224 as against 1,277. The reactor-percentage increased from 0.19 to 0.29 per cent.

New Areas, tested for the first time, contained a higher level of infection than Areas tested for the first time last year. The figure for first-round testing was 0.36 per cent reactors, as against 0.20 per cent in the previous year. There was also a significant increase in the number of reactors detected during retest of herds by Departmental officers; 1.21 per cent, as against 0.83 per cent last year.

The number of reactors in herds which in previous years were apparently free of infection was higher this year. Twenty reactors were found in a herd which yielded none in 1961, 1962, and 1964. Twelve were advanced cases. A retest of the herd three months later disclosed eight more reactors, and five were advanced cases. Investigations failed to reveal any means whereby the disease could have been introduced.

Fifteen positive and 17 doubtful reactors were detected in another herd where all cattle had been negative in 1964 and 1965. Subsequent retest disclosed 25 reactors. A neighbouring herd, with a similar history of freedom from the disease and to which no cattle had been introduced, yielded six reactors in the 75 tested. Such occurrences as these caused considerable concern.

The proportion of reactors wherein no lesion was found at slaughter, increased; from 30.0 per cent in the previous year to 32.9 per cent this year. In one herd, 29 of 34 reactors failed to show lesions on slaughter. In this herd Johne's disease had previously occurred. There may have been cross-sensitivity with the causal organism of Johne's disease.

Statistics of testing done this year are in the following table:

	Cattle Tested	Reactors	Reactors Per cent	NVL* Reactors	Reactors NVL Per cent
1st Round	164,680	591	0.36	129	21.8
2nd Round	216,040	253	0.12	87	34.4
3rd Round	141,846	238	0.17	93	39.1
4th Round	119,608	245	0.20	78	31.8
5th Round	834	2	0.24	..	..
Retests	65,976	796	1.21	308	38.9
Introductions	52,683	99	0.19	36	36.4
Totals	761,667	2,224	0.29	731	32.9

* "No Visible Lesion"

Tubercle-Free Herd Scheme. In this voluntary scheme of accreditation, 62 herds (10,795 head) were tested. There was no reactor. Forty-eight other herds, accredited in the previous year for two years, were not tested.

Tubercle-Free Milk Schemes. One scheme, applying to the larger cities, is administered by the N.S.W. Milk Board. Under this scheme, 29 herds (8,131 head) were tested. There were 19 reactors.

Municipal and Shire Councils supervise the other scheme. This operates mainly in the smaller cities and towns. Testing was done in 31 areas (4,491 cattle tested). Five reactors were detected.

The two schemes operate on similar lines and aim to ensure that raw milk sold for human consumption is produced by herds accredited by the Department.

Miscellaneous Testings. These testings included compulsory testing of infected herds, and voluntary testing—for export, sale, exhibition, or diagnostic purposes. Cattle tested totalled 41,559, and 490 reacted.

Testing continued on several large beef-cattle stations previously found to be heavily infected and where testing had been started before the end of the year.

One of these beef-cattle stations had been tested regularly since 1962. In that period 21,981 tests were applied and 723 head removed as reactors. Of these, 159 were found on slaughter to be either generalized cases of the disease or to possess lung lesions; 493 had lymph gland lesions, and 71 showed no lesion.

Amendments to the Stock Diseases Act were effected this year. These provided for compulsory identification of all cattle being consigned for sale or slaughter. This will enable the property of origin to be determined when cattle are found infected at slaughtering establishments.

Tuberculosis (Pigs)

This year 740 tuberculin tests were applied to pigs. There were 30 reactors, all in one large commercial piggery which had been found heavily infected the previous year and where control measures had been started. The organism proved to be of the avian type but with reduced pathogenicity for fowls.

The disease was originally diagnosed in the piggery when 75 per cent of consignments of baconers to an abattoir had been found infected. Although there was a significant level of infection in breeding stock, it was found that many of the pigs were becoming infected between the ages of 4½ and 7 months. The tuberculin test in this herd failed to pick out more than 50 per cent of the affected pigs.

Towards the end of the year, there was considerable decline in the proportion of pigs found infected on slaughter. The source of the piggery's infection has not been determined.

Tuberculosis (Poultry)

Twenty-six properties were placed in quarantine for avian tuberculosis; a considerable reduction on the 56 outbreaks detected in the previous year. Twenty-nine holdings which were previously placed in quarantine were released.

All but one of the infected properties detected this year were in the recognized enzootic area, in the southwest. The exception was a flock near Tamworth, in the north. Avian tuberculosis killed 40 in this flock of 1,500 hens and pullets, and there were symptoms in 10 per cent of the flock. Of 600 consigned for slaughter, 170 were found affected. Source of infection was not determined.

GENERAL DISEASE PROBLEMS

Air Sacculitis (Turkey Poults)

Many mortalities in turkey poults between 2 and 8 weeks old were investigated. In at least one of the necropsy findings was an air sacculitis. *Mycoplasma meleagridis* was isolated from several cases, but its role as a pathogen was not determined, as salmonellosis and possibly hexamitiasis were found to play a part, either independently or concurrently.

Ataxia (Sheep)

An ataxic condition affecting sheep reappeared. It has been sporadic for many years in the northwest. On past experience, the occurrence coincides with rainfall after a dry period, and this year marked the end of a severe drought in the area. The

syndrome is a progressive ataxia, starting with the hind limbs and usually fatal—although sheep have been kept alive for long periods by care and individual attention. The cause is not known. A toxic plant is suspected.

Black Disease (Sheep)

There were three substantial mortalities from black disease. The sheep should have been protected, having been vaccinated with multiple vaccines containing anti-black disease components. In each case, post-mortem examination indicated black disease, and in two of them *Clostridium novyi* was in the smears prepared from lesions. Guinea-pigs inoculated with liver material died within 24 hours and showed typical *Clostridium novyi* infection.

The outbreaks confirmed previous evidence that the black-disease components of multiple vaccines may lose potency, particularly when the vaccines are held for a time.

Bloat (Cattle and Sheep)

High rainfall in the spring, in much of the inland, produced conditions conducive to bloat. There were many cattle mortalities. In one mob of 600 travelling cattle, 5 died and 150 needed treatment. Cases were reported in cattle grazing barley grass (*Hordeum murinum*) and young oats. Some losses were also reported in sheep grazing clover-dominant pastures.

Blow-fly (Sheep)

Spring rains promoted conditions favourable to blow-fly strike in the early summer. Further, there was a strike-wave in autumn. In the northwest, there was evidence of the flies' increased tolerance to organo-phosphate insecticides widely used as strike-preventatives. The carbamate insecticide buticarb became available commercially and towards the end of the year at least one case of its failure to protect sheep for more than two weeks was reported.

Brucellosis (Cattle)

Brucellosis continued to be widespread. Numerous investigations were made of abortions arising from it. Strain 19 vaccine was used on a voluntary basis. One case of apparent failure of strain 19 to protect against infection was investigated, where heifers were being inoculated at 12 months of age. As the herd was heavily infected, it seemed that infection was occurring before vaccination.

To assess incidence, with a view to possible introduction of eradication measures, an extensive survey was done in the Hunter River Valley. Milk ring tests were applied to the bulk milk of some 2,700 suppliers at 11 milk depots and butter factories. In the case of 4 factories the testing was repeated after 3 months while, at 2 factories, 3 tests were done at 3-months' intervals.

Positive reactions recorded at the different factories varied from 20 to 52 per cent of suppliers, with a mean of about 37 per cent. Slight reactions were given by milk from a further 8 to 33 per cent of owners. Repeat-testing generally revealed only minor differences in the proportion of samples reacting but at one factory, where 25 per cent of samples had been positive, a repeat-test resulted in 48 per cent giving positive reactions. In the latter case, factory procedure may have caused some milk consignments to be contaminated with milk from other farms.

To determine the significance of slight reactions in bulk samples, cows in two herds for which this type of reaction was recorded were individually sampled and submitted to the milk ring test. One cow in each herd gave a strong positive reaction.

At one factory, the testing of each can of milk received was compared to tests of the bulk milk from each individual owner. Cans tested totalled 927, from 174 suppliers. Positive reactions were returned by 17.4 per cent of the cans, compared to 20 per cent of bulk milk supplies.

At two factories, the reactions given on bulk milk from strain 19-vaccinated and non-vaccinated herds were compared. At one of these, 23 per cent bulk milk supplies from vaccinated herds returned positive reactions as against 47 per cent from unvaccinated herds. At the other factory, the respective figure was 34 per cent and 48 per cent.

At the latter factory, reactions were analysed in relation to the period for which strain 19 vaccine had been regularly used. Where the vaccine had been in use for seven years or more, reactions were given by 25 per cent of samples, compared to more than 40 per cent where the vaccine had either not been used or had been used for a shorter period.

Limited surveys based on the milk ring test were done in two other areas. In the central west, milk samples from 71 suppliers yielded 58 per cent positive; on the northern tablelands, milk from 48 per cent of 16 suppliers was positive.

A limited survey of the incidence in beef cattle, based on the serum tube agglutination-test, was done on the central tablelands; 120 serum samples, obtained at random from 43 properties, yielded nine positive and two doubtful reactors. The positive reactors came from eight properties.

Reports from the Department of Health, of cases of brucellosis in humans, were followed up to determine if infection arose from direct or indirect contact with livestock. Six such cases were investigated. In one instance, involving a town resident, the herd from which the person had obtained milk was tested. There were 43 positive and 11 doubtful reactors in the 147 cattle in this herd. To help local authorities in the area to determine a policy in regard to sale of unpasteurized milk, the whey-tube agglutination-test was applied to 714 milk samples from 17 herds. There were 51 positive and 15 doubtful reactions. Six herds did not show any evidence of brucellosis, while four showed more than 14 per cent reactors.

The voluntary brucellosis-free herd scheme was maintained. Six herds continued on the accredited-list. Cattle tested for accreditation, export, exhibition and diagnosis totalled 7,371. Of these, 859 were positive and 277 doubtful.

Brucellosis (Sheep)

Brucellosis was diagnosed often as a cause of epididymitis and infertility in rams, and in a few cases as a cause of abortion. The voluntary brucellosis-free flock scheme, started in the previous year, did not prove popular with breeders. Only one flock was tested with a view to entering the scheme.

Complement-fixation tests done for export, sale, diagnosis and the accredited scheme totalled 4,340. Of these, 430 were positive and 66 doubtful.

Coccidiosis (Poultry)

Despite widespread use of coccidiostat-medicated feed, particularly in broiler production, there were many outbreaks. *Eimeria tenella* and *Eimeria necatrix* were the predominant species. Most cases were complicated by concurrent diseases, including infectious bronchitis-uraemia or chronic respiratory disease. Presumably such diseases reduced the feed-intake and thus the coccidiostat-intake, allowing coccidiosis to take effect. Some owners changed from continuous coccidiostat-administration to periods of 2 to 3 days at fortnightly intervals, with apparent effective control.

Enteritis (Calves)

A scouring syndrome of new born beef calves has been a major problem on properties on the central tablelands. This year it occurred on a large scale over a wide area of the State. Seasonal conditions leading to a flush of feed, and high milk-production by newly-calved cows, seemed to be a predisposing factor. The response of affected calves to antibiotics or nitrofurans was generally good but in some herds up to 10 per cent of calves died. The practical difficulty of treating calves individually on most beef properties was a serious problem. *Escherichia coli* was isolated from a limited number of affected calves.

Enteritis (Sheep)

There were outbreaks of a scouring syndrome in a number of flocks. It mostly responded to sulphadimidine treatment. The symptoms were not primarily due to coccidiosis, but this disease could have been contributed in some cases. The primary cause was not determined.

Enterotoxaemia (Sheep)

Mortalities occurred over a wide area despite an increase in vaccination through the advent of multiple vaccines. Spring pastoral conditions favoured the disease. There were mortalities of up to 15 per cent. In some cases, losses continued after an initial vaccine-injection and until after a second vaccination. Some outbreaks in lambs were associated with heavy tapeworm-infection. Several outbreaks with significant losses were in autumn in sheep on dry feed, under conditions not usually conducive to the disease.

Epididymitis (Rams)

Actinobacillus lignieresii caused epididymitis affecting 14 of 250 rams in a Border Leicester stud. Lesions were mainly confined to the tail of the epididymus, but some sheep showed lesions in the head of this organ. There was also orchitis in some rams. On examination a month later most of the infections had cleared, with some regression of lesions.

Experimental intraepididymal-inoculation of the organism into unaffected rams caused lesions like those in the affected flock. Attempts to infect rams by intravenous injection, supra-junctival installation and intrapreputal installation were unsuccessful.

Fowl Cholera

There were many outbreaks of cholera affecting fowls and turkeys. Outbreaks involving turkeys were significantly more numerous than usual. In general the losses were light, but mortalities of 127 in 700 and 250 in 800 turkeys occurred. Most cases responded to sulphaquinoxaline. In one case this was not effective but streptomycin succeeded. The septicaemic form of the disease was most common but the cranial type was also seen.

Goitre (Lambs)

A severe outbreak of goitre caused loss of 700 of 3,000 lambs from 4,000 Corriedale ewes on a highly-improved property in the southwest. Necropsies were done on 123 lambs, and 66 showed thyroid glands enlarged up to 3½ oz. Goitre-incidence varied a lot as between paddocks. From one group of maiden ewes, about 90 per cent of the lambs had enlarged thyroids. Some were parenchymatous goitres and others were transitional parenchymatous-colloid goitres.

Haemorrhagic Enteritis (Turkeys)

Haemorrhagic enteritis caused occasional but significant losses on turkey farms. Intestinal smears consistently showed *Clostridium*-like organisms in quantity. Many *Clostridium perfringens* were recovered pathogenically and were almost identical with the type from cases of necrotic enteritis in broiler chickens.

Hypocalcaemia (Sheep)

Losses through hypocalcaemia were widespread as a result of spring rains promoting lush growths of pastures and crops. Most were associated with grazing oats. Generally, hypomagnesaemia did not seem involved.

In the far west also, hypocalcaemia was a major cause of sheep mortality—despite dry conditions. The two main causes were consumption of plants rich in oxalates, and stress factors. Mustering in the very large paddocks, mostly by motor cycle or jeep, occupied a considerable period—sheep often were deprived of feed for up to two days. Long distance trucking was also a cause.

Hypocuprosis (Cattle)

Copper deficiency, known to exist in parts of the north coast areas, was this year diagnosed for the first time in the Hunter River Valley. On two properties there were low blood and liver-copper levels in cattle showing poor condition, pale coat, and scouring. Liver-copper level in one animal was 16 ppm, while blood-copper levels varied from 0.01 to 0.03 mg per 100 ml. As in previous cases in cattle in this State, the deficiency appeared to be a conditioned one—pasture samples showing normal copper levels. The land was low lying and poorly drained, characteristic of north coast country where copper deficiency has occurred.

Infectious Bovine Rhinotracheitis (IBR)

IBR in ocular, upper respiratory tract and encephalitic forms was several times suspected in widely separated parts of the State. In one case the brain of a bull which died after symptoms of encephalitis showed histopathological lesions consistent with IBR.

Infectious Bronchitis (Poultry)

There was sustained incidence of this disease, with increase in the colder months. Mostly, 4 to 6 weeks old birds were involved but younger birds were also affected. Most cases were of the nephritic form, the earlier and milder respiratory involvement having been overlooked by owners. Losses in affected

flocks generally were about 5 per cent but some were heavier. Electrolyte replacement and the administration of citrate was used and seemed beneficial. Vaccination was not widely used, and in some cases did not prevent the disease—possibly due to incorrect administration.

Infectious Laryngotracheitis (ILT), Poultry

Incidence of ILT was high. Most outbreaks involved broilers and were in the ocular form of the disease, with little mortality but severe economic loss through retarded growth. Outbreaks also occurred in layers, and mostly in the tracheal form. In some cases the ocular form progressed to tracheal involvement, causing mortalities of up to 30 per cent.

In the Tamworth ILT Protected Area, the disease now appears to be established. The virus responsible is of low virulence and up to the end of the year had been stable. In most affected flocks, the incidence was low and tracheal changes were mild. A very occasional bird showed a haemorrhagic tracheitis.

Diagnosis of the disease as occurring in the Tamworth area, presented some problems. Inoculation of susceptible birds yielded less than 20 per cent clinically affected; lesions were extremely mild and generally not pathognomonic.

Leptospirosis (Pigs and Cattle)

Leptospirosis was the most common cause of abortions and still-births in pigs. *Leptospirosis pomona* was involved mostly but, in one case, five sows with a history of dead litters returned negative serological reactions to *L. pomona* but positive to *L. hyos*. Leptospirosis also caused some abortions in cattle.

Leucosis (Poultry)

Marek's disease accounted for 84 per cent of the total leucosis cases examined at Glenfield Veterinary Research Station. Incidence was greater than usual. The disease was particularly important in broiler flocks, with mortalities of up to 25 per cent. The increased incidence may have been due in part to processors accepting birds at 11 rather than at 9 weeks as previously.

Mastitis (Dairy Cattle)

Mastitis continued to be one of the major diseases of dairy cattle. In the many problem cases investigated, *Staphylococcus* appeared to be the main pathogen. Organisms, penicillin resistance was widespread. From time to time resistance was noted also to streptomycin, ampicillin, spiramycin, and chloramphenicol.

Stricter action was taken this year to discourage consignment of milk containing antibiotic residues to depots and factories. Penicillin issued without veterinary prescription was required to contain a marker dye. Tests for dyes and antibiotics were done at factories. There were some problems, such as positive Keogh tests being returned 4–19 days after use of antibiotics either by intra-mammary infusion or parenteral injection.

Mycotic Dermatitis

Mycotic dermatitis became very prevalent on the tablelands during the summer months, a result of above average spring rainfall, with long wet and humid periods. The disease mainly affected young medium and strong woolled Merinos, but did infect some fine woolled Merinos as well as crossbreds. Up to 20 per cent of some flocks were severely affected.

Necrotic Enteritis (Poultry)

Necrotic enteritis continued to be a problem in broilers in the Tamworth District. Control was good by use of feed medicated with either penicillin or furazolidone. The organism *Clostridium perfringens* was regularly isolated. Its growth needs and cultural characteristics were studied at the District Veterinary Laboratory, Armidale.

Oedema Disease (Pigs)

This emerged as the main cause of mortality in pigs. Control was based on reducing post-weaning feed intake, adoption of creep-feeding prior to weaning, and use of antibiotics.

Poisonings

Algal poisoning (*Anacystis cyanea*). Some severe mortalities in sheep and one in turkeys followed the consumption of dam water contaminated with the blue-green alga *Anacystis cyanea*.

Earlier examinations of infested water for toxicity incriminated the scum, but tests this year showed the filtrate also to be poisonous when it becomes blue. There is apparent association between gas formation and toxicity. Several samples with negligible odour and gas formation were non-toxic when injected into mice at the standard dose.

Arsenic. Arsenical poisoning was confirmed for the first time in sheep treated by spray dipping. Of 71 lost from 1,100 dipped, 63 were lambs aged six months—still with their dams. Rain during the afternoon and overnight followed dipping. Analysis of tissue confirmed the diagnosis.

Heliotropium europeum. Favoured by seasonal conditions, heliotrope growth was prolific in the infested southwest. Mortalities in sheep with access to the plant was substantial over a wide area. All ages were affected. Highest losses were in the 2½–4 years age group.

Preliminary results of use of cobalt bullets to prevent poisoning have not indicated a favourable response.

Ryegrass Staggers (*Lolium perenne*). Incidence of ryegrass staggers was exceptionally high on the central and southern tablelands, starting in March and ending in June. Up to 50 per cent of some flocks showed the symptoms. The occurrence followed a dry period, when grass dried off, then light rain which produced green shoots at the base of dry plants. The grass lost its toxicity when useful rain in May and relatively mild June weather promoted growth. Deaths were not a feature of the toxicity on most properties but, on some, losses were appreciable where sheep were not removed from the affected pasture. There were symptoms on some properties where perennial ryegrass was extremely limited in a paddock.

Photosensitization (*Panicum laevifolium*). Vigorous growth of the native pasture species *Panicum laevifolium* caused widespread photosensitization in sheep, in summer and autumn.

***Palaris tuberosa*.** This pasture species did not develop toxicity on the scale of two years ago, but in some mortalities it was incriminated. The losses that did occur were in most cases heavy, and usually followed the turning of hungry sheep on to a pure stand of the grass. A 10 per cent mortality occurred when hoggets were placed in a paddock not stocked with sheep for three months but which had continuously carried cattle with no ill effects.

Sodium fluoroacetate ("1080"). Some sheep and cattle mortalities followed the laying of baits impregnated with "1080" for rabbit destruction. Most cases were when light rain after a dry period moistened the dehydrated baits, but one case involving loss of 25 per cent Merino wethers was when a treated paddock was not stocked until after 4½–5 in of rain.

Thiabendazole. A 25 per cent mortality in Corriedale ewes followed drenching with thiabendazole. Many others in the mob were sick but recovered. The sheep had been held three days, for crutching, with restricted water intake, then drenched with thiabendazole before release.

St George Disease (Cattle)

Cases of St George disease occurred in cattle in the far west. Many cases occurred on poor feed, but some were on sparse but not poor feed and others on good grass, salt bush and burr pastures. Many affected animals recovered when hay and concentrates were fed, or after a change in paddock to better feed. Specimens did not reveal *Bartonella* spp., suspected in South Australia of a role in the aetiology.

Salmonellosis (Turkeys)

Salmonella derby and *Salmonella singapore* were isolated from poults at a turkey-raising establishment where mortality has occurred over a long period in the 4–7 weeks age-group. Study of the pathogenic roles of these two organisms is continuing.

Sporadic Bovine Encephalomyelitis (SBE)

SBE was widely prevalent among beef cattle, particularly in the northwest. Most losses were sporadic but there were several cases of significant mortality in calves.

Swine Pox

An epizootic of swine pox occurred on the north coast in the autumn when mosquitoes were prevalent. Many pigs were affected, with up to 60 per cent mortality in new born piglets.

Tetanus (Sheep)

There were some heavy mortalities in sheep. Most cases in adult sheep were from contamination of shearing wounds. In lambs the disease tended to follow castration by rubber rings. Advent of multiple vaccines containing an antitetanus component meant that more sheep than hitherto received inoculation against this disease.

Urinary calculi (Sheep)

Urinary calculi were noted on several occasions in the far west. Calculi from fat wethers dying on one holding were mainly calcium carbonate and magnesium carbonate, with some organic matter and a trace of phosphate. Calculi from wethers on two other holdings in the same region had a high cystine content, an unusual component.

Vibriosis (Cattle and Sheep)

Cattle. Vibriosis continued to be a major cause of infertility in dairy cattle. Some 1,092 samples of vaginal mucus, from 158 herds, were submitted to the agglutination test. Positive reactions were given by 77 samples, from 31 herds. Incidence of the disease has been reduced by wide use of artificial insemination.

Sheep. A number of outbreaks of vibronic abortion in sheep occurred. One holding sustained a 70 per cent lamb-loss in a group of 330 Merino ewes 3–4 years old. There had been no introduction of sheep for many years. Carrier birds were thought to be a likely source, as extensive grain-feeding had been practised towards the end of pregnancy and birds in large numbers were attracted. *Vibrio* spp. were isolated from one of five crows killed on this holding.

Worms (Cattle)

Worm-infestation was a problem on many properties. There were many cases of adult cattle affected with *Ostertagia* spp. and some deaths. *Cooperia* spp. was the most serious worm in young calves. Other species involved were *Haemonchus*, *Oesophagostomum*, *Bunostomum*, and *Dictyocaulus*.

Worms (Sheep)

Sickness and mortality in sheep, from helminthosis, was considerable. This was especially when a dry spell followed a wet period and reduced nutrition to sub-optimal levels. The situation occurred in several regions. Most frequent species were *Haemonchus*, *Nematodirus*, *Trichostrongylus* and *Ostertagia*. In lambs there were cases caused by heavy infestations of *Moniezia* spp.

A strain of *Haemonchus contortus* resistant to thiabendazole emerged in four flocks on the northern tablelands towards the end of the year. This came under notice through failure of repeated dosing, at recommended levels, to ameliorate clinical symptoms. Faecal samples from recently-treated sheep yielded up to 1,800 eggs per gm. On culture the eggs yielded almost 100 per cent *Haemonchus contortus* larvae. Studies at the District Veterinary Laboratory, Armidale, confirmed the strain-resistance to thiabendazole.

Miscellaneous Animal Health Services

Extension Service by Veterinary Personnel

Considerable, personal-contact extension work was done by veterinary officers and veterinary inspectors when investigating flock- and herd-problems and in meeting stockowners at such places as saleyards and field days. Group- and mass-media extension were also undertaken.

Some 41 sessions were conducted at schools for farmers organized through various primary producer bodies, most commonly the Agricultural Bureau. Demonstrations were given at 12 field days. Forty-seven meetings were addressed. Sixty radio broadcasts were made and two telecasts were staged in association with an exhibition at a country show.

Veterinary Services at Government Institutions

Departmental veterinary officers provided clinical and disease control services to livestock located at Government farms; 281 such services were given. The work included disease-testing, diagnosis, treatment, vaccination, surgery, dehorning, necropsy, and pregnancy-determinations.

At Glenfield Veterinary Research Station bird faeces were examined for the virus of psittacosis for the Military Hospital Concord. Also, human-skin biopsy-material from the Prince Henry Hospital was examined for the virus of contagious pustular-dermatitis.

In-service Veterinary Training and Conferences

Schools. Thirteen veterinary officers and 13 veterinary inspectors attended a refresher course on the principles of dairy health and production, conducted for Departmental officers by the University of Sydney. Also, twelve veterinary officers attended a pesticides school organized by Division of Science Services and two veterinary officers and a veterinary inspector attended the extension methods school conducted by Division of Information Services.

Conferences. There were two conferences of senior veterinary officers; also a conference of veterinary officers and veterinary inspectors in the north-eastern district.

The Assistant Principal Veterinary Officer (Exotic Diseases) represented the Department at the annual conference of the Australian Veterinary Association, and other officers attended in private capacity. Thirty-three veterinary inspectors attended the annual conference of the Veterinary Inspectors' Institute.

Test Mating of Bulls

All bulls intended for use at artificial stock-breeding centres in New South Wales are test-mated at Glenfield Veterinary Research Station for the diagnosis of possible genital infections. While at the Station the bulls are tested also for tuberculosis, brucellosis, leptospirosis and contagious pleuropneumonia. Thirty-one bulls were so tested this year.

Rabbit Myxoma Virus

Requests for myxoma virus for infection of rabbits for destruction purposes have maintained a relatively uniform rate since 1960. This year there were 338 requests, and about 70,000 rabbit doses were despatched intrastate from Glenfield Veterinary Research Station. Small orders from other States were also filled. The number of doses despatched for within the State was slightly less than in the previous year (79,950) but well above that of the three years up to 1965-66.

A new method of supplying myxoma virus is being considered. It involves the application of a dried powder containing the virus, and an abrasive powder, directly into the rabbit's eye. The need to use a hypodermic syringe would be eliminated.

Diagnostic Services—Glenfield and Armidale Laboratories

In previous years, the total numbers of specimens received for examination have been recorded. A more accurate assessment of the situation is provided by the total of consignments of specimens. The receipts at Glenfield Veterinary Research Station and the Colin Blumer District Veterinary Laboratory, Armidale, are set out in the following table:

Specimens	To Glenfield	To Armidale
Cattle	2,796	289
Sheep	1,386	413
Poultry	1,561	182
Pigs	500	73
Horses	58	10
Other Animals	215	8
Plants	137	4
Miscellaneous	201	13
Totals	7,054	992

The next tabulation shows sources of the diagnostic material received at the two laboratories:

From	To Glenfield	To Armidale
Veterinary officers	2,157	284
Veterinary inspectors	1,746	475
Veterinary practitioners	1,690	170
CSIRO and Universities	..	30
Owners etc.	1,461	33
Totals	7,054	992

Veterinary Notes (Periodical Bulletin)

As from the start of 1967, the periodical *Veterinary Notes* designed to take to the veterinarians investigating and controlling stock diseases in New South Wales the latest relevant research-findings has been produced at three-month intervals in lieu of six-month intervals.

Stock Foods and Medicines Act

Stock Foods Registrations. Applications approved for registration totalled 1,863. Registration was refused or deferred in 137 cases pending further information or corrections of labels accompanying the applications.

Check-analyses on Registered Stock-Foods. Specimens of 30 samples of stock foods being offered for sale were collected for analysis to determine whether the composition conformed to what was stated in the application and on the label. The fat content of two samples of meat meal, and the phosphoric acid content of another sample of meat meal, exceeded the maxima guaranteed by the manufacturers. One sample, analysed following mortality in birds receiving the feed, had been contaminated with lindane.

Stock Medicines Registrations and Inspections. The Stock Medicines' Board considered 1,804 applications for registration of stock remedies. Registration of three applications was deferred, and 31 were withdrawn by applicants. Inspections were made to ensure that antibiotics sold for treatment of mastitis without veterinary prescription contained marker dye as required by the Board. Inspections were also made to ensure that organo-chlorine preparations, all of which had been deregistered by the Board, were not being sold as stock remedies.

Cattle Compensation Act

Claims and Payments. Claims approved for payment totalled 7,996, compared to 7,014 in the previous year.

The totals of cattle and of carcasses for which compensation were paid, and the aggregate payments, showed similar increases on the previous year's totals. The comparative figures were 11,192, against 10,644, and \$364,125 as against \$324,623.

The Diseases Concerned. Diseases for which compensation was paid, and the amounts, are shown in the following table:

Disease	Claims	Animals	Payments
			\$
Tuberculosis	1,111	2,586	118,227.90
Cancer	3,718	4,827	114,734.05
Actinomycosis	2,444	2,852	78,108.72
Actinobacillosis	685	868	20,584.34
Pleuropneumonia	2	2	200.00
Tick Fever	32	48	2,073.10
John's Disease	4	9	197.31
Totals	7,996	11,192	364,125.42

The claims Disallowed or Reduced. The 147 claims for which compensation was disallowed comprised 89 for delayed notification of disease by owners, 34 for failure to notify diseases, 15 for failure to pay levy or submit return, and 9 for delayed application for compensation.

In 88 other cases the amount of compensation payable was reduced because the claims were not submitted within 60 days of the slaughter of the cattle.

The Compensation Fund. Income for the year was \$400,492; from levies paid by stockowners, stamp duty on cattle slaughtered, and fixed-deposit interest on portion of the fund. Expenditure for the year was \$391,730, including compensation payments and administrative expenses. Excess of income over expenditure was \$8,762, and at 30th June, 1967, the amount standing to the credit of the fund was roundly \$1,775,926.

Board of Tick Control—Cattle Tick Control

ERADICATION MEASURES

The Situation in Various Areas

Drake Area. The policy of surveillance was successfully completed in December, 1966. The Area was then released from quarantine.

Buccarumbi Area. The two Areas to which tick-infested cattle were moved from Grafton Area in 1965, were maintained free of stock and subsequently released from quarantine.

Kempsey Area. This Area at Crescent Head, to which infested cattle also were moved from Grafton Area in 1965, was kept free of stock and subsequently released from quarantine.

Coutts Crossing Area. This Area was placed in quarantine in February, 1967, because of movement of cattle off a tick-infested holding in the Legume Quarantine Area. Eradication measures were commenced in May, 1967.

Boonoo Boonoo Area. This Area was placed in quarantine in March, 1967, because of movements of cattle from holdings in the Legume Quarantine Area before infestation with cattle tick was found in January, 1967. Eradication has been scheduled to commence in July, 1967.

Tick Fever

Babesiosis Cases. This disease remained a problem within the Tick Quarantine Areas but not as serious as during 1964-65 and 1965-66.

Seven clinical cases—six due to *Babesia argentina* and one to *Babesia bigemina*—were confirmed. In each case only one animal was involved.

Of the six outbreaks due to *B. argentina* four were in the Kyogle Area and the other two in the Tweed Area. The outbreak due to *B. bigemina* was in the Bonalbo Area, in a dairy herd established several years ago with cattle from the Kyogle Area. Apart from this outbreak, the cases were all in Quarantine Areas adjoining the Queensland Border.

Blood testing of cattle on adjoining properties detected carriers of *B. argentina* on 11 holdings. Four of these were in the Kyogle Area and seven in the Tweed Area. Carriers of *B. bigemina* were found on two farms in the Kyogle Area.

Control measures used over the past few years appear to have been very effective. This year it was possible to release 32 holdings. The stock on these had been dipped every 14 days

for a year and had then been negative to the complement-fixation test for babesiosis. The quarantine of one property had to be extended because a carrier was detected at the end of the quarantine period, and in another case because of incomplete musters. This year 38,775 cattle were bled for complement-fixation testing.

Incidence of tick-fever carriers was surveyed by random selection of properties between the Tweed River and the Queensland border. Cattle tested totalled 15,755, on 247 holdings. *B. argentina* carriers were found on two holdings.

No carrier was detected in 3,093 cattle tested for movement west of the Richmond Range and to the Copmanhurst and Grafton Areas. This requirement was discontinued as from March.

Anaplasmosis Cases. Carriers of *Anaplasma marginale* were detected on a property close to the Queensland border, in the Woodenbong Area. These cattle had been bled because presence of cattle tick was detected on the holding in March, 1966. The holding is being treated the same as for an outbreak of babesiosis. This is the second recording of anaplasmosis in the tick quarantine areas. The previous one was in 1949 in the Kyogle Area.

At 30th June, 1967, the position in regard to tick fever outbreaks and carrier holdings placed in quarantine, was as follows:

Area	Tick Fever Outbreaks 1964-65	Tick Fever Outbreaks 1965-66		Tick Fever Outbreaks 1966-67		Tick Fever Holdings Released 1966-67
		Holdings	Cattle	Holdings	Cattle	
Kyogle	87	19	2,510	10	1,042	24
Tweed	6	4	412	11	1,155	6
Richmond	3	1	92	..	..	..
Woodenbong	8	..	..	1	204	2
Bonalbo	..	..	..	1	104	..
Totals	104	24	3,014	23	2,505	32

CONTROL POLICIES

Areas East of Richmond Range

Stock on all holdings in the Richmond, Tweed, and Kyogle Areas, except the Rappville Section of the Richmond Area, were given nine treatments at twenty-one day intervals between October, 1966, and April, 1967. Calves under three months old were examined instead of dipped, due to risk of poisoning. In the Rappville Section, six treatments were undertaken, starting in November, 1966.

Restrictions remained in force, requiring examination and treatment of all moving stock. Due to an improvement in the tick-fever position in Kyogle Area, requirements for movement of stock out of the area were relaxed and brought into line with those applying in the other areas east of the Richmond Range.

Further improvement in the position regarding infestations detected is shown in the following table:

Area	1963-64	1964-65	1965-66	1966-67
Richmond—				
Bangalow	19	36	2	3
Lismore	24	75	9	2
Nimbin	13	20	8	7
Casino	67	108	20	12
Rappville	..	3	..	..
Kyogle	60	53	5	3
Tweed	12	33	3	..
Totals	195	327	47	27

Most of the infested holdings had a history of infestations, extending over a number of years.

Areas West of the Richmond Range

Tabulam, Bonalbo, and Woodenbong Areas. There was no organized policy of treatments, but voluntary treatments were encouraged. This failed to meet with the response desired. Very few stockowners availed of the facilities provided by the Board. The policy in the Tabulam and Bonalbo Areas of examining stock prior to movement, and in Woodenbong Area of examining and treating, was continued. The number of infestations detected in these areas was less than in the previous year, but certain problem-holdings again drew attention.

Legume Area. In January, cattle ticks were detected near Central Koreelah and Acacia Creek on seven properties in an area where ticks were previously eradicated. The Legume Quarantine Area was therefore regazetted. Movements traced from these infested holdings on to five properties south of the legume area resulted, also, in the re-establishment of the Boonoo Boonoo Area.

In the legume area, a policy of 21-day examinations of stock on all holdings was introduced. In all, 6,783 cattle were examined, on 54 holdings. No further infestation was detected and this policy was terminated at the end of April. Stock on infested holdings received four treatments.

Queensland cattle which could be carriers of tick fever were present in the area, so stock moving to other areas were required to be tested for this disease, as well as inspected for cattle ticks and dipped twice. The movement of Queensland cattle except for immediate slaughter was prohibited.

Boonoo Boonoo Area. A policy involving treatment of stock leaving suspect holdings, and examination of all other moving stock within the area, was implemented. But no tick was detected. Careful examinations on holdings adjoining the legume quarantine boundary in the Lower Koreelah Creek Area also revealed no ticks.

It was decided that a policy of eradication should be undertaken in this area. This involves the dipping of stock on the suspect holdings at fourteen-day intervals for a period of six months, starting in July, 1967. Stockowners were given

the option of either dipping their stock or leasing their holdings to the Board for this period. In the latter case all stock would be removed. The period of eradication in this instance was determined as a result of tick-life studies in the area.

Considerable organization was necessary to provide gating, boundaries, and dipping facilities.

Infestations West of the Richmond Range. The following are statistics of infestations detected in each of the past four years:

Area	1963-64	1964-65	1965-66	1966-67
Bonalbo	1	4	1	2
Tabulam	1	2	11	5
Rivertree	1	..	..	..
Woodenbong	..	13	2	7
Legume	..	..	..	..
Boonoo Boonoo	..	..	..	..
Totals	3	19	14	14

Grafton and Copmanhurst Areas

The policy of examining moving stock was continued. Also, the stock on holdings where infestations were detected in 1965 (Pillar Valley) and 1966 (Palmer's Channel) were examined at twenty-one-day intervals until the end of April. No further tick was found.

In June, 1967, another holding was found infested at Fine Flower, in the Copmanhurst Area. Stock on all adjoining holdings were examined, but no cattle tick was detected and the origin of this infestation remained undetermined.

Arrangements are in hand for stock on the infested holding to receive four treatments at twenty-one day intervals, followed by twenty-one-day inspections for twelve months.

INSPECTIONS IN AND OUTSIDE THE QUARANTINE AREAS

Tick Inspections of Stock at Abattoirs

The policy of retaining staff at Macksville, Grafton, and Tenterfield Abattoirs was continued. The cattle ticks on cattle from the infested holding at Fine Flower in the Copmanhurst Area were detected during examination of stock at the Grafton Abattoirs. This emphasized the need to continue these examinations.

Again, large numbers of *Haemaphysalis* and *Ixodes* ticks were found at the Macksville and Grafton Abattoirs, but no evidence of tick life was detected at Tenterfield. At the Tenterfield Abattoirs the unloading of cattle arriving by train from Wallangarra and the dipping of all ex-Queensland calves prior to slaughter continued to be supervised. At the Casino and Byron Bay Abattoirs, within the tick quarantine areas, calf carcasses were examined after skinning and removed ticks were found. No *Boophilus* spp. and very few other ticks were found.

At these abattoirs the slaughter of cattle from tick fever holdings and cattle introduced from clean country continued to be supervised.

Examinations in Clean Country

Inspection teams again operated in clean country outside the Grafton Area, particularly at Buccarumbi, Chambigne, Halfway Creek, and Corindi, from January to June. No evidence of cattle tick was found. Operations of the team in clean country west of the Woodenbong Area detected the infestations referred to in an earlier paragraph.

CLAIMS FOR COMPENSATION

Compensation claims totalling roundly \$6,382 were paid for the loss of 153 head by death or injury during dipping operations, as compared to roundly \$7,539 for 186 head in 1965-66.

Losses suspected as due to organo-phosphate poisoning were confined mainly to animals under 12 months old. Deaths per 100,000 head dipped averaged 3.07 for ethion, 1.62 for delnav, and 0.46 for asuntol.

FENCING, DIP, AND HUT CONSTRUCTION

Quarantine boundaries were improved by erecting some 23½ miles of new fence, and extensive repairs to some 51½ miles of existing fence. Progress of fencing programmes was hindered by the need to use many of the staff to establish the Legume and Boonoo Boonoo Areas, and also by adverse weather.

The dip gang did extensive repairs in the Tweed, Lismore, Bonalbo, Legume, and Boonoo Boonoo Areas. Five dip-yards were completely rebuilt. Members of the field staff also repaired dips (454) and attended to the gravelling of dip-yards (128).

Thirteen new huts and cottages were built, twenty-one were renovated, and seven tents were roofed, mostly for patrol officers and gatekeepers in the Tabulam, Woodenbong, Legume, and Boonoo Boonoo Areas.

STAFF NUMBERS

The year was started with a ministerial staff of 512 and ended with 507 employed. It was necessary to appoint additional staff in the Legume and Boonoo Boonoo areas, but this increase was offset by a reduction in staff from the release of Drake Area and a curtailment of fencing and maintenance work. During the year 149 staff transfers were effected.

TOXICITY OF ACARICIDES

The mortality rate in cattle was kept satisfactorily low by maintaining the hair deposit of dips below 4 mgm/gm of hair. But there were some losses where the hair deposits were even well below this figure, particularly in young animals.

The policy of converting dips from delnav to ethion, particularly where there were high hair loadings, was continued, but it became apparent that these acaricides behaved similarly. Moreover, data from claims recommended by the Board indicated that ethion caused twice as many losses as delnav per 100,000 cattle dipped. Therefore, comparatively few delnav dips were converted to ethion this year. At 30th June, 1967, there were 524 dips charged with ethion and 811 with delnav.

STATISTICS OF DIPPINGS, AND LABORATORY ANALYSES

In the cattle-tick control activities, 2,166,545 cattle were dipped in delnav, 2,408,460 were dipped in ethion, 217,063 were dipped in asuntol, 26,658 were dipped in sevin, and 3,773 in trithion; a total of 4,822,499 cattle. Also, 1,936 horses were dipped.

The dip samples analysed totalled 13,078, the animal tissues analysed totalled 3,593, the animal products analysed totalled 499, and there were 11,316 hair-dunking tests.

Queensland Border Control

Inspectors to control the introduction of Queensland cattle totalled 69. Of these, 61 were full-time and eight part-time employed.

STOCK MOVEMENT DETAILS

The total of cattle moving from Queensland to New South Wales was comparable with the previous year's total; 244,098 this year and 238,866 last year. But the total of sheep entering showed a marked increase; 999,354 sheep this year, as against a total of 397,630 all stock but cattle last year.

Fewer sheep and cattle moved to Queensland than in the previous year.

Numbers of stock which moved from Queensland to New South Wales during the year are set out in the following table:

Stock from Queensland to N.S.W.

Section	Cattle	Sheep	Pigs	Horses	Goats
Stanthorpe	115,663	26,368	27,182	2,234	154
Goondiwindi	102,857	420,085	388	5,075	376
Mungindi	25,578	552,901	..	2,303	4,379
Totals	244,098	999,354	27,570	9,612	5,309

Stock from N.S.W. to Queensland

Section	Cattle	Sheep	Pigs	Horses	Goats
Stanthorpe	21,594	205,448	4,038	1,413	..
Goondiwindi	29,719	243,001	408	705	..
Mungindi	2,107	103,355	..	368	..
Totals	53,420	551,804	4,446	2,386	..

BORDER CROSSING FENCING, BUILDINGS

Wallangarra Crossing. A four-lane roadway at the main Wallangarra crossing was completed by Tenterfield Shire Council in co-operation with the Department of Main Roads. The gates and gate office were resited 325 ft on the southern side. Department of Agriculture contributed part of the expenditure. Improved lighting has facilitated vehicle inspections at night.

Stanthorpe Fencing. New fencing (2½ miles) was erected in the Stanthorpe section, the cost shared by this Department and the Darling Downs-Moreton Rabbit Board.

Buildings. New office accommodation was built at the Mungindi crossing. Two new staff cottages were erected in Goondiwindi section. In Stanthorpe section six camping units were erected at sites along the border to reduce the need for tents.

Meat Inspection Service

STAFF

The establishment strength at 30th June, 1967, comprised the Principal and Assistant Principal Veterinary Officers, two other Veterinary Officers, 199 Meat Inspectors (all grades), including one position vacant for a Senior Inspector, and twenty brand-boys.

ABATTOIR INSPECTIONS AND CARCASS CONDEMNATIONS

Post-mortem Inspections

At time of slaughter, post-mortem inspections were fulfilled at the State Abattoir, Homebush Bay, at 22 country abattoirs, and at two small slaughterhouses in the Sydney area.

The carcasses inspected comprised: 5,738,008 sheep, 600,727 pigs, 568,078 cattle, and 319,583 calves; a total of 7,226,396 carcasses.

Ante-mortem Inspections

Cattle at Flemington Saleyards (twice weekly) and pigs at Homebush Bay Saleyards (once weekly) were inspected, and all animals at abattoirs were inspected before slaughter.

TOTAL-CARCASS CONDEMNATION DETAILS

Reason	Cattle		Calves		Pigs		Sheep	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Actinomycosis	15	·003	..	..	..	..	..	..
Arthritis	49	·008	113	·036	1,643	·273	2,331	·041
Caseous lymphadenitis	..	..	..	..	..	..	1,441	·025
Cysticercus ovis	..	..	..	..	..	..	249	·004
Emaciation	194	·034	19	·006	23	·003	6,130	·107
Sarcosporidiosis	1	..	..	..	..	..	481	·008
Septic Conditions	173	·030	65	·020	649	·108	267	·005
Tuberculosis	556	·098	6	·002	70	·012	..	..
Other Conditions	640	·113	913	·285	471	·079	2,904	·051
Totals	1,628	·286	1,116	·349	2,856	·475	13,803	·241

Partial-Carcass Condemnation Details

Reason	Cattle		Calves		Pigs		Sheep	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Actinomycosis	11,605	2.042	11	·003	..	..	..	..
Arthritis	1,652	·290	51	·016	4,039	·672	7,800	·136
Caseous lymphadenitis	..	..	..	..	..	..	12,060	·210
Septic Conditions	138	·024	10	·003	299	·049	209	·003
Tuberculosis	503	·089	4	·001	787	·131	..	..
Other Conditions	4,931	·869	106	·033	8,774	1.461	3,429	·060
Totals	18,829	3.314	182	·056	13,899	2.313	23,498	·409

Cattle-liver Condemnations

Although the condemnations of livers are not recorded in total, a random sample survey of 2,000 per month provided the following details: 22.5 per cent condemned for liver fluke, 1.5 per cent condemned for hydatid, 1.0 per cent for telangiectasis, 1.0 per cent for adhesions, and 1.3 per cent for abscesses.

Sheep Liver Condemnations

Similarly, although the sheep-liver condemnations are not recorded in detail, a random sample of 4,000 per month yielded the following details: 11.4 per cent condemned for *Cysticercus tenuicollis*, 4.0 per cent for hydatid, 0.7 per cent for C.L.A., 11.5 per cent for liver fluke, 1.4 per cent for parasitic condition, 0.8 per cent for adhesions, 0.1 per cent for melanosis, 0.4 per cent for contamination, and 0.1 per cent for other reasons.

Cysticercus bovis

Revised inspection procedures resulted in the finding of suspect *Cysticercus bovis* lesions in 63 hearts and two masseter muscles. Lesions in 45 cases were submitted to the Veterinary Research Station, Glenfield, for detailed examination. Recognizable scolices were present in seven cases, and the rest were thought to be degenerating cysts of *C. bovis*.

OTHER INSPECTIONS

Other activities included reinspection of all meat introduced into the metropolitan abattoir area, supervision of hygiene in meat handling, inspection of horses at a pet-food knacker, inspection of shops, and inspection of smallgoods factories. Shop inspections totalled 2,642.

Service Under Commonwealth Quarantine Act

Division of Animal Industry continued to administer certain sections of the Quarantine Act, 1908-1966 for the Commonwealth Government. The staff strength remained at two veterinary officers and seven port inspectors for the quarantine work at Sydney and Port Kembla, whilst the Newcastle District veterinary officer and one port inspector did the work at Newcastle.

IMPORT INSPECTIONS

Animal Imports

Importation of cattle, sheep, goats, and pigs into Australia remained totally prohibited, and routes by which horses could be imported from the United Kingdom were limited.

In almost all classes of animals the imports were higher than in the previous year. The exceptions were birds, zoological animals, and animals for research.

Two deliberate attempts to smuggle birds into N.S.W. from overseas by air were detected. An illegal attempt by parcels post to introduce reptiles, some of them venomous, was also discovered.

Import of Animal Products

Imports of fishmeal, meatmeal, and stockfeed concentrates continued to increase. Imports of animal casings, feathers, furred skins, glue pieces, and hair also increased.

Large imports of a canned pet-food from the United Kingdom caused three-fold increase in the quantity of tinned meats imported, but with the establishment of a factory in Australia this type of import has now ceased.

The import quantities of hides, skins, raw shells, wool, and cheese decreased, although imports of wool and cheese were still considerable and in excess of 3,000,000 lb.

Legislation was introduced early in the year to tighten control over the importation of butter and cheese. Following representations, the Director of Quarantine deferred the implementation of the cheese legislation and it was later revoked.

Passengers' Baggage

Co-operation with Customs officers continued, in searching for illegal goods in the baggage of passengers arriving by sea and air. Quantities of prohibited imports such as salami, other meat products, home-made cheese, egg noodles, and other foods were seized—in quantities comparable with previous years.

Illegal importations of food and other materials of animal origin are amongst the most serious matters facing the animal quarantine service. The problem is growing, through continued increase in passenger arrivals. In 1966-67 there were 87,101 passenger arrivals by ship, and 294,688 by aircraft; compared with 85,933 and 271,656 in 1965-66.

The Department of Customs and Excise introduction of a system of semi-oral declarations for people arriving by air was closely watched. Investigations revealed no indication that any item of quarantine interest was being missed under the new system.

Parcels Post

Continued attention was given to the clearance of quarantine-interest parcels at Sydney, Newcastle, and Port Kembla from overseas. The quantities of prohibited goods seized was greater than in previous years.

Incidence of falsely labelled and unlabelled tinned meats from "the East" increased considerably. Most cases were deliberate attempts to import prohibited foodstuffs. Through technical difficulties the addressee cannot be prosecuted.

Disinfection of Footwear and Clothing

The disinfection of footwear and work clothes owned by certain incoming air passengers, passengers who had been associated with rural industries overseas, continued. It is a precaution against introduction of foot and mouth disease. This year 2,316 shoes were disinfected and 17 articles of clothes, from 698 passengers, were detained for laundering.

Supervision of Ships' Pets

Supervision over pets on overseas ships visiting Sydney and Newcastle was strict. On occasion, ships' officers were instructed to tighten precautions against escape. On five occasions the bond signed by a ship's master was estreated because the pet(s) had escaped. Escape of such animals, possible carriers of an exotic disease, is regarded seriously.

Armed Service Establishments

Animal quarantine problems arising at the Richmond RAAF Base through arrival of service aircraft from overseas were reviewed. Staffing, though limited, was arranged to meet certain regular arrivals.

In co-operation with Department of Customs and Excise, a quarantine officer accompanied Customs officers to Brisbane to board the H.M.A.S. *Sydney* so that the returning Australian army personnel and the vessel's crew could be cleared. The clearance went smoothly, and enabled immediate disembarkation at Sydney.

EXPORT INSPECTIONS

Export of Animals

Supervision over export of animals continued. It involved inspection and in some cases treatment.

Exports of day-old chickens decreased for the third year in succession (from a peak of 735,765 in 1963-64 to 166,329 in 1966-67). Apparent loss of markets in Malaysia and Singapore accounts for most of the decrease. Horse, goat, pig, and bird export totals also decreased.

Cattle and sheep exports increased. This was mainly due to large shipments of cattle to Ceylon and Okinawa, and of sheep to China.

Dog exports again increased. In all, 1,503 dogs were sent to 33 different countries, 475 to the U.S.A., 342 to Hong Kong, 180 to New Zealand, and 122 to Malaysia. The trade in pedigree dogs, a large proportion of the exports, remained firm.

This Division co-operated with the Commonwealth Department of Primary Industry and the Prime Minister's Department for the export of 24 sheep to Canada for display in the Australian exhibit at "Expo '67". Housed at the Animal Quarantine Station the sheep were educated to a special diet, and treated in accordance with the Canadian and the U.S.A. import requirements. The two Merino rams in the consignment were vasectomised to avoid contravening the export embargo on Merino breeding-sheep.

LIAISON WITH OTHER SERVICES

Good liaison and co-operation was maintained with the Department of Customs and Excise and the General and Plant Quarantine Services.

Pastures Protection Section

Changes in Field Officer Establishment

Senior Field Officer Mr D. R. Stark retired on 31st January, 1967. Former Field Officer at Wagga Mr D. A. Kennedy was appointed to the Senior Field Officer position in March. The number of Field Officer positions has been increased from two to three—one at Sydney, Wagga, and Dubbo respectively. Through resignation of the Field Officer working from Sydney and promotion of the Wagga Field Officer, two of the three Field Officer positions are vacant.

Rabbit-Control Schools and Field Days

School No. 20 was held at Armidale, to train Rangers and Rabbit Inspectors in the use of "1080" (sodium fluoroacetate) poison. During this school a field day was held for the benefit of Directors and staff of Pastures Protection Boards.

A "1080" field day was held also in the Camden district, at the request of the Pastures Protection Boards' Council of Advice. This was in May, 1967, during the Annual Conference of Pastures Protection Boards, and was well and keenly attended by conference delegates.

Plague Locust Outbreak and Control

An extensive Plague Locust outbreak occurred. This was during the spring and summer; mainly in central western and southwestern areas. Aerial spraying of migrating flying-swarms was undertaken, but limited by unsuitable weather conditions. Helicopters were used to survey infested areas and direct control actions.

Field staffs of several Pastures Protection Boards were also given training in and experience of recommended techniques and control measures.

For detail of the outbreak and activities, see under Entomology Branch—DIVISION OF SCIENCE SERVICES, page 97.

Travelling-Stock Reserves

At 30th June, 1967, there were 733 applications in hand, from various persons, for areas of travelling-stock and camping reserves which Pastures Protection Boards were unwilling to release. Twelve months ago there were 473 in hand.

Field Officers were able to inspect 221 reserves subject of the applications, and 100 of these investigations occurred during the last quarter of the year. Processing of the reports has not been completed.

The number of applications not dealt with will be reduced by more than a hundred since in many instances there were more than one application for portion of the same reserve.

Pastures Protection Boards' Staff-Statistics

	At 30th June, 1966	At 30th June, 1967
Veterinary Inspectors	33	35
Secretaries	55	56
Rangers	66	66
Rabbit Inspectors	68	74

The Molong Pastures Protection District

In November, 1966, the Minister removed from office all Directors of the Molong Pastures Protection District. He appointed the Pastures Protection Officer as Administrator. The Administrator will continue in office until a Board is formed.

It is anticipated that sufficient nominations will be received to permit a Board to be elected when the next triennial election occurs in September, 1967.

Dingo Destruction Subsidy Increased

The amount of subsidy payable to Dingo Destruction Boards was increased by 40 per cent; from 50 cents for each dollar of rate-income collected, to 70 cents in the dollar.

September Elections for Pastures Protection Boards

The Pastures Protection Act was amended during the year to allow for triennial elections of Directors of Pastures Protection Boards in September instead of in April as heretofore.

Livestock Health—Research

VETERINARY RESEARCH STATION, GLENFIELD

Laboratory Techniques

The Fluorescent Antibody Technique. This was applied routinely to identify the causal organism in clostridial infections in sheep and cattle. An interesting observation was the frequency with which *Clostridium novyi* was observed in tissues, particularly liver, from animals dead for several hours before autopsy. The significance of this finding is being investigated. Work continued on preparation of conjugates for *Clostridium perfringens*.

Immunological Preparations. A supply of acetone-precipitated soluble protein from allantoic fluids was prepared. It is needed to absorb anti-egg protein antibodies from sera prepared against egg-grown viruses.

Sheep anti-rabbit globulin antibodies were prepared by inoculating sheep with their own red cells. The red cells had been washed, sensitized with rabbit-origin haemolysin and re-washed. Immuno-electrophoretic analysis of the antisera indicated that there had been non-immune absorption of rabbit-serum proteins to the sheep red cells. The work was therefore repeated without washing the red cells before sensitization. Anti-sera have not been analyzed for activity and specificity.

Estimation of Creatine Phospho-kinase. Practical application of the technique was examined to evaluate its usefulness as a measure of muscle damage in animals. Results suggested that normal field-influences and transport periods of up to 48 hours before freezing do not greatly affect the result.

Digestibility of Plant Lipids by Sheep. This was further examined, but results for beta-carotene and alpha-tocopherol have not been processed. These techniques were included in a survey of cattle sera to establish "normal" levels under varying circumstances. Procedures for determination of vitamin A levels in animal tissues were examined.

Serology. Experimental work was directed to standardization of complement-fixation tests for various diseases, including accurate complement-assay. Antibody molecular-type patterns in the *Brucella* agglutinin responses to vaccination and infection were also examined, with regard in particular to the sensitivities of antibody to reduction by 2-mercaptoethanol.

Millipore Filters for Isolations of *Vibrio* spp. Isolation of vibrios from crow-droppings by using millipore filters was successful and will be used in appropriate circumstances. Filters of pore diameter 0.65 μ were successful but the size 0.45 μ was unsuitable. However, use of these filters considerably reduced the recovery rate of vibrios from the filtrate, compared with the number in the test-sample.

Internal-Parasites Research

Cattle. Observations on dairy and beef calves dropped in spring, 1966, on the far north coast showed that in the faecal worm-egg of *Haemonchus*, *Cooperia*, and *Oesophagostomum*, seasonal fluctuations were very similar to those of previous years. A single anthelmintic-treatment of beef cattle at weaning was found to be of little value in overcoming the slowed rate of winter growth.

This year observations were extended to the New England and Riverina areas.

The possible value of pepsinogen-estimation to assist diagnosis of bovine ostertagiosis was further investigated. Excellent correlation was found between worm-burden and pepsinogen-levels in artificially-infected calves, but this relationship was not so well defined in naturally-occurring infestations. There were relatively high levels also in apparently healthy cattle.

Efficiency of several anthelmintics against arrested *Ostertagia* larvae in grown cattle was assessed. None was very effective.

Factors leading to arrested larval-development in *Ostertagia* were examined. Single large doses of larvae resulted in little arrested development, but the percentage established and the percentage arrested increased when larvae were administered sequentially over periods of up to 18 days.

Sheep. Seasonal fluctuations in nematode egg-counts of sheep continued to be studied in a variety of situations within the State. At Grafton and Trangie, the performance of untreated sheep and of those receiving anthelmintic treatment monthly were compared. Grazing trials at Shannon Vale, Trangie, Cowra, Temora and Wagga studied the incidence of worm parasites in sheep at different stocking-rates, with other management variations superimposed in some cases. Observations at Deepwater, on a system of very high stocking-rates for short periods, were continued under the supervision of the Armidale District Veterinary Laboratory.

A trial at Cooma compared the effectiveness of carbon tetrachloride, hetol (Hoechst) and hilomid (Astra) in preventing losses from *Fasciola* on a problem property. All three anthelmintics, given at 8-week intervals from December, 1965, to August, 1966, prevented losses and promoted good body-weight gains. Six of forty sheep died in the untreated group. Carbon tetrachloride given orally showed higher anthelmintic-activity than the same dose given subcutaneously in peanut oil.

Toxicology Research

Heliotropium europeum. Observations continued in the flocks containing groups treated with cobalt bullets as a possible preventative of poisoning. Considerable losses occurred from this plant alone or in conjunction with copper poisoning, but only limited data were available. However, losses occurred in both treated and untreated groups with typical histopathological changes in liver.

Sorghum spp. Eighteen samples of sorghum-hay from six sources were analysed for total hydrocyanic acid, and were kept in paper bags in a metal bin until re-analysed eleven months later. Original concentrations ranged from nil to 0.09 per cent. Loss over eleven months' storage ranged from nil to 30 per cent of the original concentration.

Macrozamia communis. Aqueous suspension of the kernels of this species were drenched to calves at rates equivalent to 5, 3.5, 2.5, 1.5, 1.0 and 0.5 g/Kg, to produce test-material for the investigation of biochemical parameters in blood. The two higher dose-rates resulted in death in about 30 hours and 3 or 4 days, respectively. The three lower dose-rates produced only transient sickness.

Ornithine-carbamyl transferase (O.C.T.) and serum glutamic oxalacetic transaminase (S.G.O.T.) were evaluated as indices of liver damage, and other changes (e.g., serum proteins and electrolytes—sodium and potassium) on material from these animals were studied. Preliminary results indicated that O.C.T. is a more sensitive and specific indicator than S.G.O.T. However, O.C.T. has been reported to be present in intestinal mucosa.

Comparison of the effects of *Macrozamia* and carbon tetrachloride showed that O.C.T. levels rise and return to normal at 6 or 7 days after carbon tetrachloride administration, but remain moderately elevated for longer periods after *Macrozamia* ingestion. This suggests a continuing component of intestinal damage after liver damage has been resolved.

Pimelea simplex (Desert rice flower). Aqueous suspensions made from mature specimens of this plant, collected near Bourke in February, proved lethal to calves and guinea pigs. They produced muscular weakness and gastro-enteritis. Further work with solvent extraction will be undertaken, to identify the toxic principle and mode of action.

Research on Newcastle Disease—Poultry

Five further Newcastle-disease virus (NDV) isolates were identified. Four had been received in 1966 and one in 1967. There is evidence that the 1967 isolates differ antigenically from those recovered in 1966.

A trial, started in the previous year, to assess the pathogenicity of one strain (66/1018) showed it to be non-pathogenic to hens, chickens (6 weeks), turkey poults (8–10 weeks) and ducklings (8–10 weeks). Natural transmission to hens, chickens and turkeys occurred, although there was some delay and a high transmission-rate was recognised serologically only after the chickens were given the freedom of the pen because of inadequate cage space.

Exhalation of virulence was thought possible if opportunity was given for rapid transmission through susceptible birds. Therefore the same strain was used to infect day-old chickens by approximately 10^7 EID₅₀ (Egg Infective Doses) given per os. New day-olds were placed in contact three times per week, and all chickens removed at one week of age. There was no evidence of disease induced, nor of virus infection beyond the first-contact group. No good explanation is available for the poor transmissibility of the virus under what were thought to be ideal conditions. But the chickens were brooded in a well-ventilated area under infra-red light, and NDV has been reported to be very susceptible to infra-red irradiation.

A trial has been started to examine the eggs of recently-infected hens for virus, and to determine whether there is egg-transmission in viable chickens hatching from such eggs.

Laboratory work incidental to various aspects of Newcastle Disease investigations included:

- purification by adsorption-elution and differential centrifugation;
- enhancement of haemagglutinating-activity (HA) of centrifuged virus-pellets by sonication;
- use of purified virus for the production of specific anti-NDV sera in rabbits for reference purposes;
- examination of effect of fluorocarbon treatment, reported to enhance HA activity;
- differentiation of NDV strains by measuring thermostability at 56°C and testing the agglutinability of various species of red cell;
- conducting tests of HA enhancement by antibody, on virus already absorbed to red cells;
- comparison of infectivity and HA titres.

A long-term trial to determine the seasonal incidence of non-antibody haemagglutinin inhibitors in allantoic fluid of 14 day embryonated eggs has started, because a series of anomalous HA patterns seemed to be due to the presence of such inhibitors. Six allantoic fluid samples have been obtained each week and held frozen. These will be titrated for inhibitors after a collection is available for 12 or more months.

Infectious Laryngo-tracheitis (ILT)—Poultry

Titration of drinking water involving one or more strains of virus were made on three occasions, on samples taken at various periods after preparation of the virus suspension in water. On each occasion there was little loss of virus infectivity before 6 hours. This indicates stability much higher than is generally supposed for ILT virus.

A virus neutralization test was developed to support field investigations into the use of a formalinised ILT vaccine in the Tamworth area. As no suitable virus strains were available for the purpose, two vaccine strains were adapted by 13 rapid passes by both chorio allantoic membrane (CAM) and

sub-allantoic routes. The neutralization tests by CAM and sub-allantoic routes were compared. The CAM route was selected. The method was used to test some 200 sera. By comparison with plaque reduction tests in chick-embryo kidney cultures, the egg method was tedious, expensive and inexact.

A gel-diffusion precipitin reaction has been obtained with ILT antigen prepared in embryonated eggs and hyperimmune serum prepared against infected CAM homogenates. The specificity and significance of the reaction are being examined.

Experiments in co-operation with the University of Sydney compared the diagnostic value of a recently described smear technique with established methods and conventional histopathology. The method seemed extremely useful in rapid diagnosis and is being further evaluated.

Duration of immunity following vaccination by the eye-drop method at 6 weeks of age is being investigated. No evidence of immunity at 26 weeks post-vaccination as reported by other workers has been obtained.

Challenge trials at three and six weeks after vaccination via the drinking water and also by the eye-drop technique were undertaken with the University of Sydney. Solid immunity appeared to occur by both methods at three weeks after vaccination. At 6 weeks the immunity produced by the eye-drop method appeared to be greater.

Further trials involved the study of a prepared inactivated vaccine. Efficiency was estimated by serology and challenge. Sterility of the vaccine was demonstrated by bacteriological culture, inoculation into embryonated eggs, and direct transmission into susceptible fowls.

Tests involved weekly intramuscular-vaccination of several groups of 7-week old birds. After six weeks post-vaccination all test-birds and 38 controls were challenged with virulent virus by the intratracheal route. The morbidity in all groups was 100 per cent with 36 per cent of deaths in the vaccinated birds and 58 per cent deaths in the unvaccinated controls. Antibody-response was demonstrated in the vaccinated birds, but no worthwhile immunity.

Studies were started in the previous year to evaluate the preventative and curative value of iodine (iodol and sanichick). Evidence has been obtained from laboratory experiments and supported by field trials, that iodine reduces the morbidity- and mortality-rates if given early in an outbreak and acts as a preventative when administration is started six days before exposure to infection. However, the effectiveness is dependent on the severity of subsequent challenge. Thus, iodine in drinking water seems of little practical value if the challenge is severe.

Vibriosis Research

Preliminary examination of four *Vibrio fetus* isolates from ovine abortions suggested that these were of two antigenic-types, relative to agglutination with immune sera prepared in rabbits. A killed adjuvant-vaccine was prepared with isolates from each of the two antigenic groups, and a laboratory trial has been set up with vaccinated and non-vaccinated animals in a small group of 40 ewes.

Survival of *Vibrio* spp. for at least eight years has been found, where the vibrios were transferred from semi-solid agar to whole-milk and lyophilised. Investigations of survival of vibrios when suspended in standard broth-serum diluent alone or in combination with whole-milk and lyophilised have started. A survival-time of four weeks has already been observed.

Contagious Pustular Dermatitis (CPD) Research

A standard stock of CPD virus was established to replace the previous practice of utilizing a recent positive-preparation from diagnostic work. Vaccine-preparations were tested as known positive-stock but their low titres rendered them relatively inconsistent. To establish a virus-stock of high potency and mutivalency a pool was prepared from some 30 positive field-specimens collected over several years, homogenized and freeze-dried. The stock available should be sufficient for use for 5–10 years as known-material. Larger freeze-dried portions are held for experiments.

An attempt was made to fix complement onto a pre-formed antigen antibody-complex. Little fixation occurred but because of the potential of the technique for eliminating pro- and anti-complementary effects, and because of current work in serology to introduce techniques for the more exact assay of complement, the technique will be examined further.

Bovine Papilloma Research

One lesion was received for vaccine-preparation. Portion of the homogenate was retained as virus-stock and portion was also inoculated to a calf and to embryonated eggs before the bulk was formalinized as vaccine. Lesions were produced on chorio-allantoic membranes of embryonated eggs. Lesions on the calf were limited, and regressed after a short period, possibly because the inoculation was made both by scarification and intra-dermal injection. The latter possibly gave a vaccination immunity.

A practitioner made use of the formalinized vaccine and has briefly reported excellent results.

Bovine Hypocuprosis Research

Evidence of copper deficiency in the Grafton area has accumulated, so opportunity was taken for periodic examinations of the status of young dairy and beef cattle (under experimental control for other purposes) by copper-determination on liver biopsy-samples at approximate three months intervals. Results at 30th June, 1967, are as follows:

Mean (range) copper ppm. of 15 spring-drop (1965) animals

	22-8-66	5-11-66	6-2-67	1-5-67
Dairy cattle	68 (18-172)	48 (14-96)	53 (15-113)	60 (9-148)
Beef cattle	21 (8-42)	15 (6-49)	21 (6-82)	27 (7-98)

The results did not show a seasonal influence on a group basis, although there were major fluctuations by individuals. There was marked difference in the results between dairy and beef animals.

Psittacosis-lymphogranuloma Viruses (PLV) Research

Preparative work was undertaken for investigations into PLV infections, including sporadic bovine encephalomyelitis (SBE), lamb arthritis, enzootic ovine abortion, and sheep pneumonia. Stocks of a PLV agent from an SBE case were established and observations were made on the effects of the virus on developing chick-embryos. Complement-fixing antigen-stocks were prepared and a trial was initiated to produce adequate volumes of control-antisera and to relate antibody-production to stages in the clinical disease.

Infectious Bovine Kerato-Conjunctivitis (IBKC) Research

To study the bacteriological characteristics of the causal organism (*Moraxella bovis*) and to compare field-strains, twenty-five isolates of the organism were collected during the summer from clinical cases in the Camden-Penrith area. Acute and convalescent serum-samples were obtained from effected cattle in different areas of the State. Preparation of hyperimmune-rabbit sera to selected strains was commenced. Eyes with lesions of all stages of infection were collected from cattle at Homebush Abattoirs. The results are not yet available.

Research on Cattle Lice Infestation

A trial at Orange compared the efficiency of diazinon spray and a "pour-on" formulation of montrel bopak as medications for lice-control. Experimental cattle were affected with *Damalinea bovis*, *Haematopinus eurysternis* and *Linognathus vituli*. Both the diazinon and the montrel gave a good kill of all three species. However, treated groups had no liveweight-advantage over untreated controls at 56 days.

Research on Marek's Disease—Poultry

A small preliminary trial was made with early and advanced cases of this disease, applying riboflavin-supplementation to rations containing the quantity of riboflavin normal for a commercial poultry ration. No benefit was seen in advanced cases, probably due to inanition, but there seemed some response in early cases of the disease.

Bacteriological Examination of Abattoir Water

Countries importing Australian meat insist that water used at abattoirs during slaughtering processes must have minimum bacterial-content. Water samples from the State Abattoirs at Homebush have been examined regularly by the recommended method, using "Millipore" filtration-equipment and special media to detect the degree of contamination with *Escherichia coli* and coliform organisms. All seven sets of samples so far examined have been satisfactory.

Eperythrozoonosis Experiment

An unsuccessful attempt was made to adapt *Eperythrozoon ovis* to the chicken-embryo by a series of blind passes by intravenous inoculation.

DISTRICT VETERINARY LABORATORY, ARMIDALE

Control of Worms in Sheep

This project continued. It is on a property under a system of continuous rotational grazing. Sixty faecal samples from the mob of 4,000 sheep were submitted fortnightly for strongyle egg-counts and larval-differentiation. Rainfall and temperatures favoured larval-survival and pick-up, but the egg-counts and worm-burdens remained low until mid-autumn. *Trichostrongylus* spp. then caused scouring and listlessness in some sheep, and in early winter the mob was drenched for the first time in two years.

Observations on recovery of larvae from pastures spelled for periods ranging from 18 to 62 days have started.

Weaner Illthrift

Lambs reared under intensive systems at Shannon Vale Nutrition Station have in past years shown illthrift, with some post-weaning mortality. A trial was undertaken to look at factors concerned. Observations were made on parasite-burdens (nematodes, cestode and coccidia) growth-weights, haematological values and blood-chemistry. Probably because of the low lambing-percentage, after the severe drought, illthrift did not occur in the lambs under observation. This project will be repeated in the coming year.

Internal Parasites of Cattle

Observations started in November, 1965, on calves at Glen Innes Agricultural Research Station. Strongyle egg-counts, body-weights and blood-serum pepsinogen levels were recorded at regular intervals on three groups of calves. Also, three animals run under identical conditions were slaughtered every two months for total worm-count observations.

Results have indicated negligible worm egg-count levels and low, non-significant worm-burdens. No significant differences were noted in body-weights of the three groups; one drenched monthly with thiabendazole, the second at weaning, and the third untreated.

Necrotic Enteritis, Poultry

Identification of the *Clostridium perfringens* type recoverable from the intestinal tract is being attempted. Observations were made on the stability of toxin kept for eight months at 4°C and -22°C. No significant difference was found in the potency of the ammonium sulphate precipitated-toxins, tested in 20 gm mice. Preliminary observations on components of toxin were made, using immuno-diffusion techniques.

Reproduction of the disease in 8-9 weeks' old crossbred chickens was attempted. The birds showed no ill-effects after daily dosing with *Clostridium perfringens* cultures together with a mineral suspension and up to 1.5 mls tincture of belladonna per bird.

Infectious Laryngo-Tracheitis, Poultry

A trial in association with University of New England, using a chloroform-inactivated I.L.T. vaccine was started on five farms. Three of these were C.R.D.-free. About two-thirds of the birds from each group were given three subcutaneous doses of the vaccine before coming into production. The vaccination programme was nearly complete at 30th June, 1967. Production records were kept to assess the value of the procedure. Some serological and pen-trial work referred to in the Glenfield Veterinary Research Station report is part of this project.

Infectious Bronchitis, Poultry

Epizootiology of infectious bronchitis is being surveyed in the Tamworth District. Samples of tracheas, kidneys and caecal nodes have been taken at three week intervals and attempts made to isolate the causal virus. So far, 135 specimens from eight farms have been examined.

Salmonella Survey at Poultry Abattoirs

In poultry abattoirs, birds are soaked in a tank of water after cleaning. Their carcasses absorb moisture and become heavier. The Department of Public Health, Tamworth, has been interested that this procedure may be a source of

contamination with *Salmonellae*. This laboratory has co-operated to survey incidence of *Salmonella* in wash-tanks at abattoirs after poultry-soaking has been completed. To date *Salmonella pullorum* has been the only species isolated (on two occasions) and this followed treatment of cull-hens.

CATTLE TICK RESEARCH STATION, WOLLONGBAR

Tick Fever Studies

Survey of Incidence. This survey was to see if there was greater incidence of tick-fever carriers on holdings adjoining than on holdings distant from the Queensland border. Of 2,174 cattle adjoining the border, 14 carried either *Babesia argentina* or *B. bigemina*. This represents 6.44 animals per 1,000 head. Of 13,827 cattle away from the border, only six (0.43 per 1,000 head) were infected. Thus it seems that infection could be crossing the Queensland border.

Agglutination-Test Developed for *B. argentina*. A simple agglutination has been developed to diagnose *B. argentina* infection in cattle. The test is not as sensitive as the complement-fixation or indirect haemagglutination tests but will detect for at least 30 months in some animals. The value might be in its ability to differentiate between strains of *B. argentina*, as a similar test is so used with malaria and trypanosomiasis. Work on a killed vaccine would be speeded if there were a simple method of identifying strains, therefore the studies are continuing.

Transmission of *B. argentina*. Infection has been transmitted by as little as 10⁻⁷ cubic centimetres of blood, intradermally and intravenously, from an animal showing 3 per cent of red cells carrying parasites. This corresponds to less than 50 parasites, and suggests possibility of transmission by needles and biting-insects.

Tick Ecology Studies

Egg-hatching and Larval-survival Studies. Studies of the hatching of *Boophilus microplus* eggs and the survival of larvae under different ecological-conditions continued. Preliminary analyses of data showed that there is no winter-break in breeding, though cold considerably retards egg-development and reduces the hatchability of egg-masses. The data also showed that small differences in temperature around the critical level during winter make for significant differences in tick-breeding. The longest pre-hatch-period recorded was 28 weeks for ticks buried in cylinders in April; significantly longer than recorded before. April ticks also produced the longest hatching-period; 16 weeks for cylinder-buried ticks. March and August ticks were much more efficient producers of larvae than were those dropped in April, May, June and July.

At one exposure-site all eggs laid by June-ticks died. The first exposures to produce larvae were 27th June in the pasture, and 1st September in the forest. At another site, ticks performed remarkably well. March-ticks gave vigorous larval colonies that lived until mid-September. April ticks did almost as well regarding hatchings, and larvae were still on the grass at the end of October. Of five May-exposures, two failed completely. However, between the start of May and the end of July (13 exposures) there were only three complete failures. There was also one vigorous larval-colony from a June-exposure; larvae emerged with the "spring-rise" at the end of October.

Following four heavy falls of rain between October and January, the grass was carefully searched for water- and wind-borne larvae but none were found in the buffer (140 feet wide) northeast of the exposed ticks. Four pairs of calves were used as bait-animals in a fenced-in lane around the site but no larvae were collected.

Dispersal of Larvae. A situation similar to that on the Queensland-N.S.W. border exists at the Station, but on a small scale: a fenced ridge with the slopes away from it northeast (normally infested) and southwest (clean). Larvae were put out on the fence-line in December and ticks were exposed in January. A larvae-catcher was erected 50 feet from the larvae and 4½ feet above grass-level. Six pairs of bait-calves were used in a small fenced-paddock a further 50 feet away.

Two larvae were recovered from the catcher. They could have been windborne from the fence or been flipped up the last few feet, having travelled the normal way from grass tip to grass tip. No tick was dropped by the calves.

Climatology. Records of daily maximum and minimum temperatures covering March to October, 1964-6, were provided by the Bureau of Meteorology for selected centres along the coastal strip from Condong to Richmond. Similiar records were obtained from the Tropical Fruit Research Station,

Alstonville. Comparisons were made between recording stations up to 300 miles south of the border and with records from ecology sites where the performance of ticks was known.

These studies lead to the opinion that the cattle tick could be a pest at least as far south as Newcastle.

Studies of Acaricide Applications

Comparisons. Repeated trials with ethion, delnav, asuntol, and rucide showed that after three treatments at intervals of seven days (the standard method of cleansing stock entering uninfested areas) cattle were not always entirely free of live ticks. Some 10 to 20 per cent of treated cattle could be expected to each drop one or two live ticks. Before treatment, test cattle were usually heavily infested so that the rate of survival was of the order of one tick per 40,000 ticks. The sites of attachment of the surviving ticks were not determined.

In one trial, treatment in a long bath was no more effective than treatment in the standard bath. The study of the effect of a bath swim of 15 seconds, or of one inch of artificial rain in one hour shortly after dipping, confirmed that ethion and delnav cattle dips were not adversely affected but rucide (used in the eradication campaign of 1956, which failed) was slightly affected.

Arsenic was again found to be strikingly inferior to ethion when compared as single treatments but when three treatments at 5 to 10 days were given the arsenic was almost as efficient as ethion.

Dursban was shown to be an extremely efficient acaricide for Wollongbar strain ticks. It almost cleaned cattle in one dipping, in two trials.

Meat Residues Studies. Attention was concentrated on problems related to residues in meat after dipping. High residues did not appear but there was a lot of variation between animals, indicating need for a large series of slaughterings. This work was done in collaboration with the Chemist, Board of Tick Control.

RESEARCH BY BOARD OF TICK CONTROL LABORATORY

Depositing Power of Dips

Observations continued on the effect of dip scooping to control the amount of active ingredient deposited in the hair of cattle. Additional evidence confirmed the benefit of scooping in most cases. Some dips did not respond favourably until soil was added to the dip bath and scooping was undertaken. This was therefore adopted as a routine practice where high hair loadings were detected.

No significant difference between hard and soft waters, on the depositing power of dips, was revealed.

Stripping Rate of Dips

Under laboratory conditions the stripping rates of under-strength and over-strength delnav dips were compared. In the limited number of tests those which were under strength had a higher stripping rate. The hair dunking technique was used.

Dursban as an Acaricide

Investigations into residue problems that might arise with dursban pointed to need of closer study of the physical and chemical properties of this acaricide under field conditions. Emulsions of 0.01 to 0.05 per cent began to crystallize out after two months, and had completely precipitated pure dursban in four months. Pure dursban solidifies at 30°C, which is below atmospheric temperature for much of the year.

Toxicity of Imidan

In a trial, mild clinical toxicity was produced in a group of calves (1½-6 months old) sprayed with imidan 0.3 per cent—four times the strength known to give a satisfactory kill of cattle ticks. At 0.02 per cent and 0.075 per cent no clinical toxicity symptom was observed, but blood cholinesterase activity was depressed.

Toxicity of Delnav after Dip Emptying

Reports received in 1965, of losses of stock which had access to dip yards contaminated with delnav dip, prompted a trial to determine whether grass contaminated with delnav emptied from a dip might be toxic if eaten. It was found that delnav persisted on grass for at least 64 days and that its half life on the grass was about 14 days. The trial suggested that cattle could be poisoned by eating grass within five days of it being heavily contaminated with delnav.

Residues in Butterfat

A 1964 trial revealed detectable residues of ethion in the butter fat of cows during the three days following dipping. The trial has been repeated and detectable residues of ethion were again found. These were highest at the first milking after dipping and fell to negligible levels in about twelve days. The half life of ethion in the butterfat was calculated to be 36 hours. There appeared no correlation between the residues and the hair deposits of ethion.

Apart from this trial, 66 butter samples were collected from Byron Bay, Lismore, and Kyogle and analysed for ethion and delnav. There were higher levels of ethion in most of the butter samples, ranging from nil to 0.78 ppm. The delnav figures were not so high, the greater number of samples (15 as against 5) showing no evidence of delnav, and levels ranged to 0.65 ppm. No appreciable decline in residues was noticed after completion of the policy treatments.

Residues in Meat Products

Eleven cattle were dipped three times, at intervals of three days, and subsequently slaughtered at one, four, and seven days after the last treatment. The dip concentrate was 0.071 per cent ethion. The results expressed as ppm of fat are as follows:

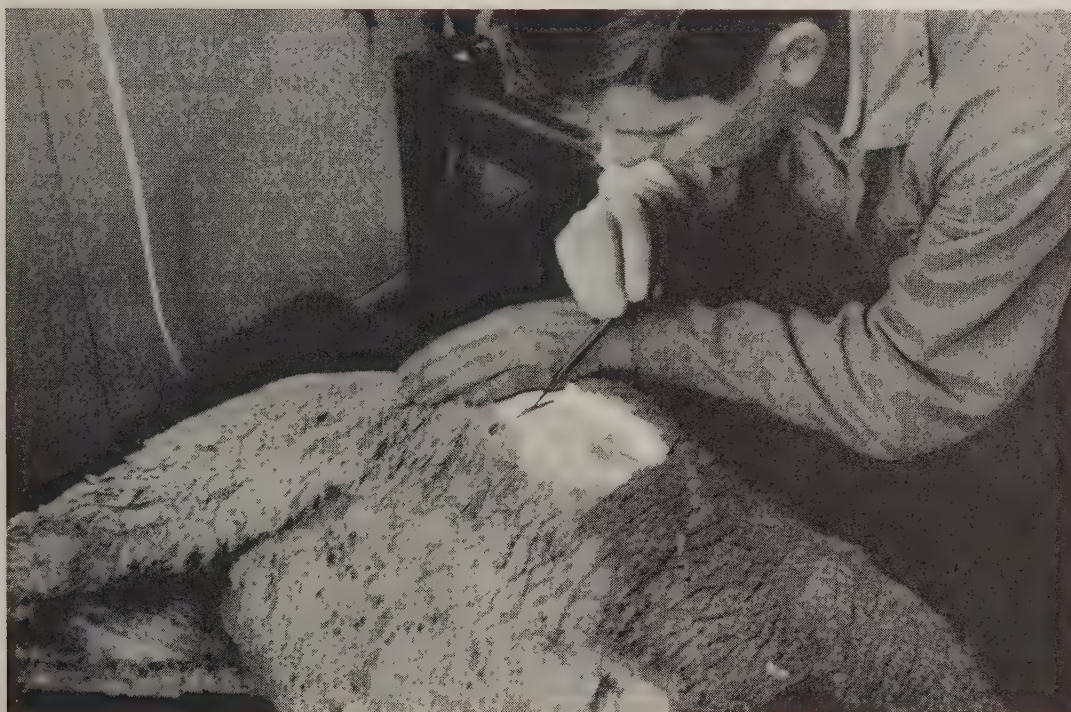
Post-dipping Interval	Ppm. of Renal Fat	
	Mean	Range
1 day	0.115 ppm.	0.00—0.38 ppm.
4 days	0.13 ppm.	0.00—0.37 ppm.
7 days	0.083 ppm.	0.00—0.21 ppm.

Another trial was started in October, 1966, using the biopsy technique for collection of fat samples. Observations were made on two groups of cattle: (i) six head dipped once in ethion and sampled 1, 2, 7, 14, and 21 days after dipping; (ii) six head dipped three times in ethion at five-day intervals and sampled at intervals as in (i). The analyses of samples have yet to be done.

The finding of high ethion residues in fat samples from animals slaughtered at Tenterfield Abattoirs prompted another trial. This was undertaken at the Cattle Tick Research Station, Wollongbar. Three groups of cattle received 1, 3, and 6 treatments in ethion and were subsequently slaughtered at 1, 4, 8, and 14 days after treatment. The analyses of samples from these animals have yet to be done.

Fat samples were collected again from abattoirs within the Tick Quarantine Areas and analysed. The results were: for DDT: of 15 samples tested, four showed nil ppm. and the rest showed levels ranging from 0.5 to 1.0 ppm.; for *dieldrin*: of 12 samples tested, all showed nil ppm.; for *ethion*: of 65 samples tested, 16 showed nil ppm. and the rest ranged up to 1.6 ppm.; for *delnav*: of 68 samples tested, 48 showed nil ppm. and the rest ranged up to 0.93 ppm.

Reports received from the Commonwealth Department of Primary Industry—of fat samples collected at Byron Bay, Casino, Tenterfield, and Grafton Abattoirs—indicated levels of ethion of somewhat the same order except that at Tenterfield some animals showed higher levels up to 4.3 ppm.



Sheep Industry Research, Trangie Agricultural Research Station

Dye-bands made at regular intervals in the wool of sheep, in the grazing-management and nutrition research, allow measurements of variations in wool-growth due to seasonal and other factors

Livestock Production Research

SHEEP RESEARCH—TRANGIE AGRICULTURAL RESEARCH STATION

Selective Breeding of Merino Sheep

The single-character selection-flocks continued to show the high heritability of fleece-weight and its components, and confirmed the presence of the strong negative genetic-correlation between fleece-weight and crimps per inch. Selection for high fold-development gave only a very small increase in clean fleece-weight because it reduced yield.

The Selection-Demonstration flock produced 15 per cent more clean wool than the Random flock and this was slightly less than the wool production of the stud. However, the stud's advantage was drawn from its high fold-development and strong wool—both undesirable characters.

The South Australian strains showed the usual characteristics of long-stapled, broad-crimping wool, large size, and freedom from skin-fold and face-cover. However the advantage in wool production was not as great as in previous years.

Selection for Weaning Weight

The weaning-weight selection flocks were joined to Border Leicester rams to examine the effects of selection within parent breeds on the performance of their crossbred progeny. The two flocks had a similar fertility but more lambs died in the Weight Minus flock both during and after birth. These losses were associated with the largeness of the lambs and probably the lower milk-production of the ewes. The progeny of Weight Plus ewes had heavier liveweights, carcass weights and better carcass grades. This shows that selection among parent strains can improve the performance of crossbreds.

Selection for Crimp Frequency

Analysis of the responses in the Crimps selection flocks showed that there was asymmetrical response to selection. In the Crimps Minus flock there was marked response to selection in the first generation, but little further response in the following few generations. On the other hand, response in the Crimps Plus flock continued at a steady rate throughout the five generations. Over the years, Peppin Merino breeders have repeatedly culled sheep with low crimp-frequency, so it is likely that genes associated with this trait have a low frequency in the population.

Shoulder-Strip Sampling

The technique of shoulder-strip sampling has been developed to allow the ranking of rams on wool production before their sale in the wool. The method entails shearing a strip of wool, the width of the handpiece, from the mid-point of the withers, over the shoulder and out along the leg. The weight of wool removed in this way has a high correlation (0.70 to 0.85) with total fleece weight. The sheep may be held in the normal shearing position and the sheep may be sampled with as little as four month's wool growth. The sample may also be used to obtain an estimate of yield. It is as accurate as the normal mid-side sample for this purpose.

A system of classing has been developed in which the shoulder-strip sampling is combined with visual classing for reserving and grading stud rams. Using this system 87 per cent of the potential selection differential for fleece weight was obtained, in comparison with 42 per cent by using visual classing alone.

The Influence of Selection on Fertility

At the 1966 lambing the March-mated flocks produced 113 per cent of lambs born and 97 per cent weaned. The Folds Plus flocks showed the strong negative association between skin folds and fertility under stress, with one of its poorest results (24 per cent lambs born). Those ewes that did lamb conceived at the end of joining. So it is likely that the Folds Plus rams were severely affected by the hot dry conditions of the first three weeks. In contrast, the Fertility flock, selected for high fertility and against skin fold, had 138 per cent lambs born.

The April-mated flocks produced 108 per cent lambs born and 92 per cent weaned, but in this case there were no systematic differences between the selection flocks. The Nucleus flock regained its high level of production (128 per cent lambs born) after its decline last year. The Bungaree flock of South Australian Merinos reverted to its low overall proportion of wet ewes (40 per cent), but those that did conceive were very fertile (63 per cent multiple births).

Efficiency of Wool Production

A feeding trial with ewes from the Crimps Plus, Crimps Minus and Random flocks was conducted. This showed that ewes from the Crimps Minus flock were significantly more efficient in converting feed to wool than ewes from the Random and Crimps Plus flocks. Also, their superiority in wool production increased as the dry-matter intake increased. The three flocks did not show any differences in bodyweight change in response to different levels of feeding. These results support those of previous years with the Fleece Weight selection flocks. The latter are, in effect, mirror-images of these Crimps flocks.

Drift-Lambing

In 1966, 13.5 per cent of lambs born in the drift, and 18.2 per cent of lambs born in the unsupervised group were lost before marking. Between marking and weaning, an additional 0.7 per cent and 2.5 per cent of lambs were lost. This means total losses of 14.3 per cent of the supervised, and 20.7 per cent of the unsupervised lambs. The post-weaning losses were the lowest so far recorded.

An experiment during the lambing indicated that marking lambs at three weeks gave similar mortalities to weaning, and similar weaning weights as when marking is at 6 to 8 days of age. Another trial suggested that dropping lambs direct into depot paddocks after marking saved some 2.7 per cent more lambs than dropping them into the depot drift-paddock and moving them into the depot paddocks four days later.

Of all lambs born (2,624) 12 per cent died. Losses from each type of birth classification were: 11 per cent of single, 11 per cent of twins, 33 per cent of triplet and 58 per cent of quadruplet lambs born. With single lambs the most likely cause of loss was the birth process, whereas the post-natal period was the most critical for lambs born in multiple births. Primary predation accounted for the deaths of 18 lambs—10 killed by crows and 8 by foxes. Secondary predation was involved in the deaths of 51 lambs; 48 of these were associated with crow attacks.

Triplet lambs born to March-mated ewes were transferred to a lucerne paddock within two days of birth, and only 17 per cent of these lambs died up to weaning. In the later lambing the triplets were left in the drift, and 49 per cent died.

Seasonal Changes in Fertility of Bungaree and Peppin Merino Sheep, Compared

Previous observations on the reproductive performance of Bungaree and Peppin Merino ewes have shown that both their oestrus incidence and ovulation rate are similar. However at lambing in 1966 there were many more dry Bungaree ewes than Peppin ewes. During autumn, 1967, it was found that the fertilization rates of ova from both types of ewe were the same. However there were very low percentages of cleaved eggs 60 to 72 hours after detection of oestrus. At this mating there was a small main effect in that Bungaree rams fertilized 8 per cent fewer eggs than Peppin rams when mated to Bungaree ewes. There was no evidence of this effect in the previous years' experiment.

Productivity of Natural Annual Pastures and Lucerne

In the second year of rotationally grazing 10 one-acre paddocks at 4 per acre, a flock of Merino ewes were mated to a Merino ram. They reared 100 per cent of lambs averaging 40 lb at 13 weeks of age. In another experiment, comparing set-stocking with two systems of rotational grazing at 5 Merino wethers per acre, rotational grazing has proved superior. Both replicates of the areas set-stocked at 5 sheep per acre had to be discontinued after six months as all the lucerne was dead. Under the rotational system the sheep have been maintained without handfeeding and with very little decrease in plant numbers.

Face Cover, Folds, Fertility

The association between face cover and various production characters was examined in eight Merino flocks. Ewes were classified as open-faced, moderate, or muffled-faced, and a flock was termed muffled or open depending on the presence or absence of muffled-faced ewes in the flock. Reproductive performance declined significantly as face cover increased in two muffled flocks, but in two other muffled and four open flocks there was no evidence of such a decline.

There was no association between face cover and greasy-fleece weight, except in two flocks where it was negative. There was a trend to inferior fleeces of finer trade-count in moderate and muffled-faced groups of several flocks. In one muffled flock, the body weights of weaner lambs declined significantly as the face cover of their dams increased. It is concluded that face cover is an undesirable attribute in Merino flocks, but its importance is greatest in muffled flocks.

Lifetime Performance of Single- and Twin-Born Merino Ewes, Compared

This year, single- and twin-born Merino ewe lambs have been compared in a further four flocks. Two of these flocks followed a similar pattern to those measured previously, namely a body-weight difference of roundly 23 per cent in favour of the singles at marking reduced to a difference of roundly 13 per cent at weaning. In another flock, the twins' disadvantage of about 20 per cent remained the same at both marking and weaning. These differences stemmed from smaller frame-size and poorer condition of the twins. However, the twins in the fourth flock were heavier than the singles at weaning, but this was apparently due to their being reared under superior conditions.

Selective Breeding of Merino Sheep for Production Characters

On several properties, a traditionally selected control flock is being compared with a nucleus and a flock selected on fleece weight and fertility. The nucleus is that portion of the ewe flock in which rams are bred for replacement in the nucleus and flock, the flock being the commercial portion of the ewe flock. Results available from the ewe-hogget shearing on one property in 1966 showed that the nucleus and flock selected on fleece weight and fertility averaged 5.42 lb of greasy fleece. Thus, they were superior to the control flock which averaged 5.30 lb.

Fleece-Lustre Mutants

The lustre mutant is a dominant gene affecting the fleece of Merino sheep. Although a dominant gene, lustre and normal matings have been given a segregation ratio which differs significantly from the 1:1 expected. The ratio observed is 1.2 normals : 1 lustre.

The lustre gene was found to decrease birthweight by 10–15 per cent and increases lamb mortality, especially the deaths before or during birth of small lustre lambs. The gene decreased fleece weight by reducing primary and secondary follicle density, and by reducing fibre length. Lustre animals had poorer jaws, less skin fold, and a greater expression of horns among the ewes, than normal Merinos.

SHEEP RESEARCH—CONDOBOLIN AGRICULTURAL RESEARCH STATION

Peppin and South Australian Merinos Compared in Crossing Performance

Considerable difficulties in effecting a spring-joining were experienced for both Peppin and South Australian strains of Merino ewe. Previous results attributing superior spring-joining ability to South Australian ewes were not markedly apparent.

The spring-mating of first-cross ewes to Dorset Horn rams became an early autumn joining. The delay was attributed to a failure of the ewes to commence cycling and a defined mating season of the Dorset Horn rams. The superiority in gross reproductive performance of the South Australian ewes was not expressed in their first-cross ewe progeny, and the Border-Peppin Merino ewes maintained a considerable advantage for all economic parameters of reproduction.

Wool production expressed as return per head favoured the South Australian ewes because of their plus 30 per cent advantage in weight of wool produced and in spite of a fluctuating price preference for the finer Peppin wool. The differences in wool production between the South Australian and Peppin Merino base ewes were reduced in their first cross ewe progeny at this hogget shearing. However, by maintaining a 9–17 per cent advantage in clean wool produced, and because of a standard market for crossbred wool, the Border-South Australian Merino had an 8–10 per cent greater economic return per head than the Border-Peppin Merino on 1966 estimates.

SHEEP RESEARCH—COWRA AGRICULTURAL RESEARCH STATION

Hybrid Vigour in Lamb Production

As in previous years, there were differences in growth rate and weaning weight between parent breeds and reciprocal cross 1966-drop lambs, and considerable hybrid vigour for these characters. This effect was much smaller for carcase measurements. When 1965-drop ewes from the four crosses were shown as hoggets, the crossbreds had a superiority of 10 per cent in clean wool production over the mean of the parent breeds.

When the F₁ ewes were joined with Dorset Horn rams in 1966, the reciprocal crosses were superior to the parent breeds in the percentages of wet ewes and multiple births and fewer of their lambs died between birth and weaning. For the two and four-tooth ewes, the superiority of the crossbreds in the percentage of lambs weaned was 70 and 50 per cent respectively.

Crossbreeding in Prime-Lamb Production

In the first phase of this trial, Merino, Border Leicester and Dorset Horn rams were joined with Merino ewes in 1964 and 1965 and their progeny compared. In general, both for years and sites, the Dorset x Merino wether lambs grew most rapidly and their weaning and carcase weights were highest. When the ewe progeny were shorn as hoggets, the Border Leicester x Merino ewes had the highest clean fleece weight. The reproductive performance of the Dorset x Merino and the Border Leicester x Merino were similar and both crosses were superior to the Merino in this regard.

Grazing Systems for Lamb Production

This experiment utilized lucerne-based pastures and compared four grazing treatments of which two were set-stocked and the other two rotationally grazed. There were no significant differences between the treatments in the wool growth of the ewes or in their lambs' growth rates. However, there was a 45 per cent reduction in the number of lucerne plants on the set-stocked treatments. These large differences in plant numbers were not reflected in differences in annual production because the other pasture components were able to support the relatively low stocking rate of 3.5 ewes per acre. Consequently the stocking rate on two of the four replicates of each treatment was increased to 5.25 ewes per acre.

Urea Block Feeding to Sheep

Dry matter and crude-protein digestibilities of low-protein roughages were not significantly increased by supplementation with urea feeding blocks.

Cottonseed as a Feed

Mature Corriedale dry ewes fed fuzzy whole-cottonseed consumed only an average 5 oz per sheep per day, and weight loss averaged a little more than 2 lb per week over an 8-week period. Two deaths from ten sheep occurred during this period and weight fell from 89 lb to 71 lb.

A group of similar ewes fed 1 lb per sheep per day of a mixture of equal parts of the same cottonseed and wheat consumed all the mixture during the greater proportion of a trial of 18 weeks. At the end of this period there were no significant differences in the mean body-weight changes nor mean clean-fleece weight of this group and a group of similar ewes fed 1 lb of wheat. The group fed wheat lost 7.3 lb and the group fed wheat/cottonseed lost 3.8 lb.

Results of biochemical changes and changes in the flavour of meat indicated that cottonseed could have some important adverse effects on body composition.

Supplementary Feeding of Weaners

Response to supplementary feeding was studied in a group of 360, 3–4 month old grazing Merino weaners for a period of 18 weeks. Three equal groups of weaners gained $\frac{1}{2}$ lb per week and an additional gain of 2 oz per week was obtained in a group supplemented with unrestricted amounts of a hammermilled mixture of three parts chopped-lucerne hay and one part oat grain. The mean greasy-fleece grown by the supplemented group was significantly greater but the cost of the supplement would appear to be greater than the increased returns from wool production and/or marked value of the sheep.

The feeding of a mineral block or providing selenium and cobalt treatments did not increase body weight gain or wool production.

SHEEP RESEARCH—YASS VALLEY

Lamb Mortality in Commercial Flocks

Trials done in 1966–67 tested the effects of two treatments on lamb mortality, and further investigated the causes of reproductive failure in the area.

Drift-lambing more than halved lamb mortality (12 per cent vs. 27 per cent for lambs from mature ewes) on a Murrumbateman district property. However, pre-lamb shearing did not significantly affect lamb mortality (29 per cent for lambs from shorn ewes vs. 33 per cent for lambs from unshorn ewes) on a Bowning district property.

Mismothering—starvation again proved to be the major cause of lamb mortality as determined by autopsy. More lambs were found to have died from difficult birth than in 1965, and less from exposure.

Sheep born early during lambing 1965 have maintained a higher body-weight than those born later. However the difference is now far less than it was at weaning.

SHEEP RESEARCH—TAMWORTH AGRICULTURAL RESEARCH STATION

Dorset Horn and Border Leicester x Merino, Ram Comparison

The 1966 joining in this trial compared heavy, medium and light-weight sires of each breed. Rams of both breeds were born as singles in the same lamb-drop, were selected on the basis of a 10-month body-weight and mated at 12 months of age. Carcase weights of lambs sired by Dorset Horn rams were 11 per cent heavier than those of lambs sired by Border Leicester x Merino rams and there was no relationship between weight of sire and carcase-weight of his progeny.

SHEEP RESEARCH—SHANNON VALE NUTRITION STATION

Sheep Breeding and Stocking Rate

Two flocks of 210 breeding ewes (105 Fleece Plus and 105 Fleece Minus) were each run under two stocking rates (2 and 6 breeding ewes per acre). Ewes stocked at 2 per acre had significantly more lambs born and weaned and there were significantly fewer mortalities among their lambs. In addition, the Fleece Minus ewes weaned significantly more lambs than did the Fleece Plus ewes.

Among the breeding ewes there was again a flock x stocking rate interaction. Fleece Plus ewes produced 23 per cent more wool than Fleece Minus at the high stocking rate while at the low stocking rate the difference increased to 34 per cent. This interaction was not present among the hoggets, because the very low weaning percentages among ewes stocked at 6 per acre in 1965 meant that all hoggets received a similar level of nutrition (the difference in fleece weight between hoggets on the two stocking rates was only 0.5 lb).

Production from Different Rates of Superphosphate and Stocking

Nine flocks of wethers each set-stocked at a superphosphate x stocking rate, superphosphate levels of $\frac{1}{2}$, $1\frac{1}{2}$, and 3 cwt, and stocking rates of 4, 8, and 12 wethers per acre are used. Superphosphate treatments had no effect on fleece weights at the 1966 shearing after the trial had been in progress for three years.

Greasy-fleece weights per head fell from an average of 12.2 lb for the wethers at 4 per acre through 8.1 lb at 8 per acre to 6.6 lb at 12 per acre. No supplementary feed was needed by the wethers at 4 per acre while those at 8 per acre were fed an average of 67 lb of oats per head, and those at 12 per acre received 180 lb per head.

Continuous versus Rotational Grazing

This trial compared a four-paddock rotational-grazing system with a one-paddock continuous-grazing system, at three different stocking-rates, 4, 8, and 12 wethers per acre. The rotational-grazing system had a large advantage over the continuous-grazing system at 8 sheep per acre but no advantage at either of the other stocking rates.

Sterile Rams and Wethers on Improved Pastures, Production Comparison

Body weights and posthitis scores have been recorded every two months and fleece weights annually on 13 sterile rams and 18 wethers which continued to graze improved pastures.

Fourteen of the 18 wethers but none of the sterile rams were scored as having posthitis. Wethers had greasy-fleece weights slightly below and clean-fleece weights 8 per cent heavier than sterile rams.

SHEEP RESEARCH—LEETON AGRICULTURAL RESEARCH STATION

Stocking Levels on Irrigated Pastures

In a pilot experiment, the production of autumn-lambled ewes stocked at 3 and 6 per acre on subterranean clover-Wimmera rye grass pastures, were studied. In addition, the value of a supplementary area (one-fifth of the total area) of paspalum-white clover pasture was assessed. The experiment was carried out over a two-year period although the experimental design differed between years.

Production per acre of lamb and wool was greater at 6 ewes per acre, but production per animal was less. At 3 ewes per acre the summer-pasture supplement did not increase production in either year. At 6 ewes per acre, however, production was increased in the second year by the summer-pasture supplement.

It was concluded that, at stocking-rates of up to 3 ewes per acre, pasture management is unlikely to affect production. The point at which pasture management begins to exert an influence lies at a stocking-rate between 3 and 6 ewes per acre.

B. Leicester-Cheviot-Merino Comparison Trial; Rams

Lambs out of Merino ewes and sired by Border Leicester and Cheviot rams were superior in all aspects to Merino sired lambs, when slaughtered at 4–5 months of age. Returns per lamb were greater from Border Leicester- than from Cheviot-sired lambs by 50 cents in 1964 and 80 cents in 1966 but there was no difference in 1965.

Results also showed that Border Leicester x Merino ewes are superior to both Cheviot x Merino and Merino ewes in terms of fertility, lamb growth rate and wool production when mated to Dorset Horn rams. The greater wool production of the Merinos was matched by the higher returns from Cheviot and Merino lambs.

Controlled Breeding of Ewes using Progestagen-Impregnated Intravaginal Sponges

In a series of experiments to investigate use of progestagen-impregnated intravaginal sponges for the controlled breeding of anoestrus Border Leicester x Merino ewes there was no consistent response to treatment. Further basic-research is needed to produce a reliable technique for the controlled breeding of anoestrus ewes.

SHEEP RESEARCH—WAGGA AGRICULTURAL RESEARCH INSTITUTE

Stocking Rate and Soil Fertility re Wool Production

This experiment, started in 1962, involved four superphosphate topdressing rates (0, 1, 2 and 3 cwt per acre) and three stocking-rates (2, 4 and 6 sheep per acre). The sheep at 6 per acre needed hand feeding in two of the four autumns because of late autumn-rains. No feeding was needed for the other treatments although the sheep at 4 per acre lost more weight each autumn than the sheep at 2 per acre. Fleece weights were 10.5, 9.5 and 8.5 lb per head for the 2, 4 and 6 sheep per acre treatments, respectively, but there was no effect from the topdressing rates. The experiment indicated that district stocking-rates can be safely doubled and it is not economical to topdress pastures where fertilizer has been applied during previous cropping.

SHEEP RESEARCH—HAWKESBURY AGRICULTURAL COLLEGE

Poultry-litter Feeding of Sheep

During a 23 weeks trial the average intake of Merino weaners, fed a mixture of poultry litter and wheat grain, was 7 oz of litter plus 9 oz of wheat per sheep per day. The average weight-gain of this group was not significantly higher than that of weaners fed 13 oz of wheat per sheep per day. At the end of the trial, sheep fed the mixture had higher levels of serum glutamate oxalacetate transaminase than sheep fed only wheat. However these higher values and bilirubin levels were below values which are associated with liver dysfunction.

BEEF CATTLE RESEARCH

Production of More Beef per Acre on Irrigated Pastures

Earlier work reported from Leeton Agricultural Research Station revealed sub-optimal growth in beef cattle grazing improved irrigated-pastures. A series of studies was undertaken on private properties throughout the Murrumbidgee Irrigation Area to assess the extent of this finding on a regional basis. Information on bodyweight gain and on the affect of various management procedures was obtained.

The seasonal and overall bodyweight gain in cattle grazing on commercial farms was similar to that obtained on the Research Station. However the pre-weaning bodyweight gain of calves varied considerably (1.5 to 2.4 lb per day) between herds on different properties.

Cattle bodyweight gain and production per acre were better from irrigated than unimproved dryland-pastures.

Pasture Intake Studies with Beef Cattle

The seasonal organic matter intake of cattle grazing irrigated pastures had been studied at Leeton Agricultural Research Station to determine whether pasture intake was limiting cattle production. A basic technique in this work is the faecal nitrogen-digestibility relationship which is used with the chromic oxide assessment of faecal output to predict the intake of the grazing steer. However, this technique is very sensitive to bias. To determine the importance of these biases on the accuracy of the technique, the relationship was determined for steers fed various fractions of an ungrazed pasture over the life of that pasture.

The results indicated that there is no consistent effect of the time of the year, leaf:stem or grass:clover ratios, nor of the animal on the faecal nitrogen-digestibility relationship. A single equation from the pooled data was acceptable and this gave a standard error of prediction of ± 3 per cent for digestibility from faecal nitrogen. This was considered suitable for field use and, together with the chromic oxide data, differences in intake of 500 g could be determined.

Performance-recording of Beef Cattle

Demonstrations on private properties have aimed at recording the performance of beef cattle for economically important traits.

The use of these records in an effective selection-program depends on minimising the environmental affects by adjusting for those which can be measured accurately. It is important to estimate the magnitude of the environmental (non-genetic) sources of variation on production traits such as birth weight, weaning weight, post-weaning gain and grade. Data collected during the years 1956-66 were analysed to provide such information. The analysis involved records on over 3,000 calves.

The results showed that for weaning weight, the age and the sex of calf and the age of its dam are the important factors for which adjustments should be made. The adjustments are of the same order as those from earlier studies, already published.

Birth weight also affects both pre-weaning gain and weaning weight. However a record of birth weight is not necessary to implement effective improvement-programmes.

Conformation grade was not consistently affected by age of dam or other environmental factors. This trait should not require adjustment in a selection programme.

Beef Cattle Improvement through Breeding Methods

The system of performance recording in the Angus stud herd at Trangie Agricultural Research Station aimed to make selection of replacement stock more effective. This was combined with a breeding programme designed to increase genetic progress for economically important traits.

Selection was based on bodyweight-gain and conformation. However, conformation, as at present assessed in the industry, appears to have little relation to carcass merit. Muscle:bone ratio is an important criterion that should be subject to improvement through selection. The variation for this trait within the herd was studied. Two series of yearling bulls not required in the breeding programme were examined.

The muscle:bone ratio in the Trangie bulls was 4.0 when adjusted to a mean carcass weight of 476 lb. This was high when compared with other bulls on which data were available elsewhere. However, although there was a wide range in muscle:bone ratio between individual bulls, it was not possible to demonstrate sire progeny-group differences within the herd.

Little information is available on the reproductive functions and dysfunctions of Australian beef bulls. Hence a full examination for breeding soundness was undertaken on all yearling bulls. This examination included a detailed scoring of serving-behaviour, semen collection and evaluation, and physical examination of the reproductive system.

DAIRY CATTLE RESEARCH—WOLLONGBAR AGRICULTURAL RESEARCH STATION

Concentrates to Supplement Tropical-Pasture Grazing

Crushed oat-grain was fed daily at the rate of 4 lb per 10 lb of 4 per cent fat-corrected milk produced in excess of 20 lb daily, to cows grazing Clarence glycine and kikuyu grass pastures. Production by supplemented cows was 30 per cent higher than that of unsupplemented cows. However, the economic profitability or otherwise of the supplement has yet to be determined.

Summer- and Spring-Calving, on Tropical Pastures, Compared

This trial, started in 1965, continued on two farmlets of about 14 acres whereon 10 spring- and 10 summer-calved cows have grazed year-round. Golden tares have been sown on about 15 per cent of the total area annually, in autumn, with the remainder sown to Clarence glycine. As well as the sown pastures, native white-clover has appeared and contributed significantly to the feed available in spring and summer.

There were marked differences in the lactation curve of the spring- and summer-calved cows. That of the summer-calved cows reached a higher early-peak but fell below that of the spring-calved cows in the later stages of lactation. However, there appeared to be little difference in the aggregate production of spring- and summer-calved animals.

Nitrogen Fertilizing of Tropical Pastures; Effect on Milk Production

On two farmlets where spring- and summer-calved cows have grazed year-round, half of each area was topdressed with 100 lb nitrogen per acre. On the area grazed by the spring-calved cows the fertilizer was applied in September, and on

that occupied by the summer-calved cows was applied in late March early April. Silver-leaf desmodium has been sown on 70 per cent of each farmlet and Clarence glycine on the rest. Addition of the nitrogen further-increased production, to a level about 2½ times that of the unimproved control. As in the trial reported in the preceding paragraph, the early results indicate little difference in total production between spring- and summer-calved cows.

Stocking Rates on Tropical Pastures; Effect on Milk Yields

Production levels with land stocked at rates of one cow to 1.5 acres, one cow to 1.0 acres and one cow to 0.75 acres were compared. The land carried a mixed grass-sward, predominantly kikuyu, with smaller components of *Paspalum dilatatum*, *Axonopus affinis* and *Chloris gayana* topdressed annually with 300 lb of nitrogen per acre in split-dressings (as sulphate of ammonia). A basal 3 cwt per acre dressing of molybdenized superphosphate/potash has been applied annually. As the level of stocking increased, production per cow decreased from 238 lb to 228 lb to 205 lb butterfat per annum. However, production per acre increased with the increased stocking rates, from 150 lb to 228 lb to 274 lb.

PIG RESEARCH—WOLLONGBAR AGRICULTURAL RESEARCH STATION

Meatmeal Quality Studies

Experiments were done to determine the value of New South Wales meatmeals as sole protein supplements for grain-fed pigs. The meatmeals produced sound performances and were adequate not only for protein but also for many necessary minerals and vitamins. Further experiments have been started to investigate the value of N.S.W. cottonseed meals in combination with meatmeals.

Carcass Studies

A series of equations were developed to predict the composition of carcasses from measurements of carcass weight, length, backfat, eye muscle and the weights of easily dissected muscles. When tested on carcasses not used in the original analysis, the prediction equations were highly accurate and will be useful in assessing results of future nutrition trials.

POULTRY RESEARCH—SEVEN HILLS RESEARCH STATION

Layer Breeding Project

The current layer breeding programme was started in late 1959. Since then between 2,000 and 2,300 pullets have been tested annually. This year the selection was made using an index dependent upon the number of eggs laid by the bird and by its full and half sisters, and also on the weight and shell-quality of a sample of its eggs. The Public Service Board's computer was used for recording. This year a gain average of 9.31 eggs per generation was made whereas over the past three years the gain average has been 9.15 eggs per generation.

Broiler Breeding Programme

The sixth selected generation of the broiler breeding programme was hatched this year. The programme was designed originally to provide broiler birds for private producers. But this need has been adequately met by commercial breeders, so the programme is used to provide birds for associated genetic investigations. Results have indicated that additive genetic variance is still responsible for much of the growth-weight variance.

Wheat Protein Levels

Previous experiments had indicated that 17-19 per cent protein wheat was inferior to 11-13 per cent protein wheat for growth in chicks. This year an experiment was done to test the addition of lysine at 0.25 per cent to 0.75 per cent. Addition of 0.75 per cent lysine to the high protein wheat diet increased the response from this diet up to that from the low protein wheat diet with no lysine added. Another experiment showed that the growth depression from the high protein wheat extended from birth to four weeks.

Unidentified Growth Factors

Following on previous experiments, five commercial sources of unidentified growth factors (U.G.F.) were tested in 13 day-old broiler chicks for a period of one week. Neither neonite nor adipantetra 6 significantly improved weight gain. Three other U.G.F. sources—fermacto, vigofac and e.c. feed were also used. The optimum level of these three sources were determined and a further experiment, testing these commercial sources against fishmeal and combinations of the sources, await analysis.



Added facilities for Poultry Nutrition Research at Seven Hills Research Station

The 1966-67 Works Programme included this modern laying-cage for nutrition research at the Poultry Research Station. See page 77, etc., for an account of the studies proceeding there.

Choline in Poultry Diets

This experiment indicated that up till six weeks, 800 mg added choline per lb gives significantly better results than any lower level. At seven to eight weeks of age chickens on 800 and 1,000 mg choline per lb showed toxic symptoms. These symptoms could be prevented by removal of choline from the diet or by supplementing the chickens through the drinking water with high levels of pyridoxine.

Comparison of Pellets, Mash and Crumbles for Broilers

A trial showed that at five weeks, birds that had been fed pellets were significantly heavier than those fed either mash or crumbles. Feed conversions for mash and crumbles were almost identical and inferior to that for pellets. During the 5-9 week period, growth on pellets was not significantly better than on mash but inferior to crumbles. There was no significant difference between treatments for feed conversion.

Growth rate over the whole nine weeks of the experiment reflected that of the first five weeks but at a lower level of significance.

Protein Levels in Sorghum, for Layers

Studies were made on crossbred pullets to compare: (i) 17 per cent protein diet based on a ration containing 77 per cent wheat, (ii) 17 per cent protein diet based on 77 per cent high protein sorghum, (iii) 16 per cent protein diet based on 66 per cent low protein sorghum, and (iv) 13 per cent protein diet based on 77 per cent low protein sorghum.

The limited results suggest that the highest level of egg production is given by diet (iii) followed by diets (i), (iv) and (ii) in that order.

Surfactants in Broiler Diets

The effect of an anionic detergent, sodium tetra-propylene-benzene-sulphonate (STPBS) on growth rate, feed conversion and body composition of broiler birds to 9 and 10 weeks of age was examined.

Broilers fed 0.5 per cent of the detergent were heavier at nine weeks than those fed 0.2 per cent and 0.9 per cent. However, there was no significant difference between treated birds and controls. Efficiency of feed conversion was higher in the group fed the 0.5 per cent level than in the controls at nine weeks. When males and females housed separately were fed the detergent at 0.5 per cent there was no difference between treated and control cockerels for weight gains and feed conversion at 5, 7 and 10 weeks. However, control pullets at the same period were significantly heavier and had better feed conversions than treated pullets.

There was no difference between groups for dressing per cent, giblet per cent, intestinal fat per cent and meat-bone ratio. The percentage of both fat and protein in the meat fraction was also unaffected by the treatment.

Feeding Space and Stocking Density on Deep Litter

Crossbreds stocked at 3 square feet per bird had a mortality rate of 15.7 per cent in comparison with 13.4 per cent for those stocked at $1\frac{1}{2}$ square feet per bird. Birds given $\frac{1}{2}$ inch, and $1\frac{1}{2}$ inches of feeder space experienced 15 per cent mortality and those given 3 inch feeder space 12 per cent mortality.

Production figures for the two stocking rates were similar but there was a graded response to feeder space; respectively 65 per cent, 72 per cent and 79 per cent hen-day for $\frac{1}{2}$ inch, $1\frac{1}{2}$ inches and 3 inches feeder space.

There was little difference in size of eggs from birds on the two stocking rates. However egg size seemed to vary with the feeder space. The figures for large (21 oz per dozen) eggs hen-day were respectively 22 per cent, 26 per cent and 33 per cent for $\frac{1}{2}$ inch, $1\frac{1}{2}$ inches and 3 inches feeder space.

Controlled Lighting for Growing- and Laying-Pullets

A lighting-regime designed to "step-down" by 25 minutes a week, from 5 weeks of age to maturity, did not affect sexual maturity of crossbred chickens compared with controls under natural light (increasing at a rate of 15 minutes per week). Both groups matured at 21 weeks of age.

Subsequently the crossbred pullets from the first part of the experiment were subject to three lighting-regimes during the laying period: (i) controls on natural light (decreasing over the period of the test), (ii) a constant 15 hours of light per day, and (iii) a "step-up" of 15 minutes per week. Production on (ii) and (iii) did not differ significantly but production of each was superior to production without supplementary electric-lighting.

Artificial Insemination

Two factorial experiments were used to determine the effect of (a) "frequency of insemination" and (b) "dose and dilution rates", on fertility in two and three breeds of chickens respectively. The semen used, in both trials, was from a group of synthetic-breed cockerels; a closed population based on White Leghorn-Australorp crosses.

In the "frequency of insemination" trial, White Leghorns were more fertile than Australorps at both weekly and twice-weekly inseminations. Australorp pullets had significantly higher fertility when inseminated twice a week compared to once a week. White Leghorn fertility improved to a far lesser extent with the more frequent inseminations.

In the "dose dilution trial", Australorp, Leghorn, and Synthetic pullets were used. With inseminations at once a week, over the three breeds, there was ninety per cent fertility when dose-dilution combinations provided between 0.03 and 0.04 ml of undiluted semen. Leghorns and Synthetics appeared more fertile than Australorps, although the differences were not statistically significant.

Protein Levels for Turkeys

A protein level of 32 per cent was found to promote greater weight-gain from birth to six weeks in Australian white poults, both male and female, than did either 24 or 28 per cent. For poults from 6 to 12 weeks, 21 per cent protein was adequate for females. The diets consisted of wheat, soybean, meatmeal, coconut meal, fishmeal, tallow, and a vitamin concentrate.

Livestock Production—Field Activities

SHEEP AND WOOL SECTION

Extension Service

General. Following the breaking of the drought in 1966 the Section's efforts were directed to increasing the overall lamb-marking percentage. Schools and courses and publicity were organized to emphasize and recommend methods for lifting lambing-percentages.

An important trend was in the further development of field-demonstration units and field-investigation projects. The number almost doubled in comparison with the previous year. These units represent the application of research-findings at property level and provide a testing-ground from which firm recommendations can be made for the adoption of new methods. Problems encountered are passed back to research workers. The service thus provides the vital link between research and industry. The swing by the producer towards a better appreciation of the use of more technical knowledge in management, has added to the importance of setting-up these units.

Trailers were supplied this year to District officers, to transport sheep-weighing scales. The recording of sheep body-weights is basic for demonstration or investigation projects. Funds for purchase of the trailers came from the Australian Wool Board Research Committee.

Activity Statistics. The following is a summary of activities, comparing 1965-66 and 1966-67:

	1965-66	1966-67	Percentage increase or decrease
Number of property visits	2,603	2,856	+ 9.4
Co-operative field investigations	52	100	+ 94.0
Ewes ranked on production	149,689	88,107	- 40.5
Value of stock purchased	\$150,153	\$190,887	+ 26.5
Demonstrations, Field Days and Lectures serviced	274	298	+ 8.7
Sales and Shows attended	126	119	- 5.6
Press statements and Radio and TV presentations	429	459	+ 7.0

The reduction in "ewes ranked on production" was due to three factors: the drought, the extension-effect of demonstrating to graziers the method of doing the ranking and selection themselves, and the increased rate of demonstrations, field investigations and other group-extension activities.

Merino Ewe Competition. This was continued, but the drought affected entries again.

Fleece Measurement Service

A charge of 50c per sample started for this service on 1st February, 1967. In spite of the charge there was no reduction in number of samples submitted for measurement.

In-Service Training

Training Courses, etc. Attendance by officers of the Section at in-service training courses was as follows: Departmental, Extension Methods School, 4 officers; Departmental, Farm Management Course, 7 officers; Commonwealth, Sheep and Wool Extension Officers Course, 3 officers; Sydney Sheep Show and Sales, 15 officers.

Annual Seminar. This seminar was held at Hawkesbury Agricultural College, and the subject this year was ovine reproduction. Full co-operation in the seminar was given by the CSIRO and the University of Sydney. Most of the speakers were from these two organizations.

In addition to the Section's livestock officers, the Department's officers who are working in sheep and wool research and the lecturers in sheep and wool husbandry at Hawkesbury, Wagga, and Yanco Agricultural Colleges attended.

Sheep for Activities on Departmental Research Stations

The total of sheep on Departmental Research Stations at 30th June, 1967, was 25,000. An account of several of the projects occurs earlier in this report of the Division of Animal Industry.

Production Trends in Sheep-Wool Industry

Adverse seasonal conditions, increased costs of production, and a low wool-market caused the industry much concern. Most producers were forced to consider critically their costs and type of production. A big swing to cereal production took place, mainly because of the previous year's drought. On properties where sheep numbers had been reduced, this was the obvious economic-course. But there was also a marked increase in acreage sown to wheat in districts that had not been severely drought-affected.

Because of the swing to cereal production there was not a big demand for sheep for re-stocking, so values of sheep remained at reasonable levels. In some districts, particularly along the central and southern slopes, a number of Merino breeders commenced using Border Leicester rams on Merino ewes. Their aim was to lift income by producing the cross-bred ewes which were in demand. Some increase in number of cattle run on sheep properties also occurred.

More interest was shown in increased stocking-rates as means to boost income, but the drought-effects prevented major moves in this direction.

Liaison with Other Departments

Assistance and advice on sheep management were given to other Government Departments. Liaison was maintained with the Lands Department in relation to Closer Settlement. Material was supplied to the Department of Primary Industry for use by the Bureau of Agricultural Economics in its annual survey of the sheep and wool industry. The data was provided by District officers in the form of preliminary and final estimates of wool-cut per head, anticipated lamb-marking percentages and changes in sheep numbers. The co-operation of the Bureau and of the CSIRO in other matters was appreciated. These organizations give valuable support at the Annual Seminars.

Close contact was maintained with and assistance given to the Rural Youth Organization. An officer of the Section was a Departmental representative in the Rural Youth Council.

BEEF CATTLE, HORSE AND GOAT SECTION

Extension Services

Activities Summary. The following is a summary of the extension activities of officers of this Section:

Radio broadcasts presented	107
Telecasts presented	54
Meetings serviced/attended	77
Conferences and symposia serviced/attended ..	21
Schools for beef cattle producers	18
Field days serviced/attended	84
Farming properties visited	954

Drought conditions greatly increased the demand for advice. Reflecting the numerical staff-situation, the use of mass media therefore increased greatly. Even so, visits to farming properties were prominent in the activities of the Section.

Agricultural Extension Grant Demonstrations. The drought conditions obliged two co-operators to withdraw from demonstration project-activity. For the same reason, only three additional owners took advantage of the benefits of undertaking a project.

Those who persevered, in most instances under extreme difficulties, did so because of their appreciation of the demonstration-project's outstanding benefits. Performance-figures for the demonstrations have underlined the continuing improvement that the beef cattle herd-improvement scheme offers to participants.

Beef Cattle Breeders' Competition. This Competition, with Agricultural Bureau and Rural Bank co-operation, has now been in operation for 15 years and has retained its value. Amendments in conditions have kept the competition in line with current knowledge.

The competition, especially through field days and publicity associated with the judgments, extends knowledge of up-to-date production methods.

Training of Officers

Three recently-appointed officers underwent training on privately-owned beef cattle properties in Northern Australia. The value of such training is now well-acknowledged and advantage of this facility will continue to be taken whilst the co-operation of property-owners in the North continues.

Beef Industry Trends

Areas of N.S.W. were affected by drought for the second, consecutive year, but methods learnt in 1965-66 were applied to good effect. The considerable increase in beef and beef cattle prices enabled producers to invest more money to keep their breeding-herds intact. This will help the industry to a "flying-start" when seasonal conditions return to normal. High prices prevailing for top-quality young beef attracted much investment into the industry.

Another side-effect of drought was greater appreciation of the merits of hand- and lot-feeding. Stemming from this and assisted by high prices, lot-feeding was exploited to some extent in several parts of the State. There are indications that the practice will expand if beef prices continue to increase.

Arab Successes at Sydney Royal Show

Of the seven Classes for Arab horses at the 1967 Sydney Royal Show, three were won by Department of Agriculture exhibits. The stallion Delos, exhibited by Wagga Agricultural College, won his Class and in turn became Champion Arab Stallion and Supreme Champion Arab Exhibit. Other Class winners were the 2-year-old colt Konrad, also from Wagga Agricultural College, and the 2-year-old filly exhibited by Hawkesbury Agricultural College.

Two Poll Shorthorn bulls exhibited from Wagga Agricultural College, whilst unplaced in their classes, were sold at attractive figures.

PIG SECTION

Extension and Regulatory Services

Activities Summary. The activities of the Section's livestock officers in their extension and regulatory duties are summarized in the following table, with inter-year comparisons:

	1963-64	1964-65	1965-66	1966-67
Farm visits	1,380	1,707	1,564	1,461
Meetings attended/serviced	52	61	68	71
Pig Sales attended	168	189	150	114
Field Days attended/serviced	14	17	32	19
Bacon Factory and Abattoir visits	74	101	66	44
College and Research Station visits	85	58	74	51
Shows attended	21	19	17	16
Lectures and Demonstrations given	64	82	84	104
Swine Branding Act, 1928, inspections	61	47	19	22
Stock Food and Medicine Act inspections	14	..	17	32
Publicity statements	41	54	113	76
Radio and Television presentations	83	72	113	83

Activity statistics for the year were reduced by the death of a District officer. His position remained vacant for four months. Also, livestock officers of the Section in three Regions acted as officer-in-charge in absence of the Regional Supervisor. These added duties were time consuming and temporarily diverted from the pig industry the officers' services.

All extension officers handled, besides the matters summarized in the tabulation, a constant stream of requests made by in-person interview, letter and telephone, for advice on all phases of pig production.

Schools for Pig Raisers. The annual school for pig raisers was held at Hawkesbury Agricultural College. It attracted 81 applicants from whom 40 farmers were selected to attend. They came from widely-dispersed parts of the State.

One-day schools were conducted also. These were at Gilgandra, Forbes, West Wyalong, and Lake Cargellico.

In-Service Training and Conferences

The training of junior livestock officers (pigs) continued at the colleges and research stations. Junior officers also attended the school for pig raisers as part of their training.

The 1966 Conference of pig-industry officers was held at Lismore, attended by all livestock officers of the Section and the research officers engaged in pig-industry problems.

Activities under Swine Compensation Act, 1928, as amended

Assistance was given in the preparation, examination, and processing of many claims following the destruction of pigs or pig carcasses because of disease. The state of the fund as at 30th June, 1967, was as follows: a credit of roundly \$488,764, compared with roundly \$336,479 a year earlier; the receipts during the year having been roundly \$162,274 and the expenditure \$9,989.

Activities under Swine Branding Act, 1940

This year 1,058 new brands and 42 new licences were issued, and 175 brands were transferred to new owners.

Departmental Herds

Large White, Berkshire, Landrace and Tamworth breeds were maintained at Hawkesbury and Wagga Agricultural Colleges and at Wollongbar and Grafton Agricultural Research Stations. The first two were used mainly for instruction and ration purposes. The Wollongbar and Grafton herds were used for nutritional and dissection studies. New bloodlines were introduced to the Hawkesbury and Grafton herds and a programme of culling aged and unsatisfactory brood stock was practiced.

A total of 1,231 pigs was disposed of, fewer than in the previous year (1,346) because there were fewer surplus pigs for marketing. Brood sow numbers were kept down but productiveness of the herds was maintained.

Assistance to other Departments and Organizations

Technical advice was given in the management of pig herds at institutions controlled by the Departments of Prisons, Health, Education and Child Welfare, and these institutions were supplied with brood stock as required. Also, Department of Technical Education was assisted by part-time teaching in their courses on pig raising. Services of the Section's livestock officers were called on by farmers organizations, the Rural Youth Movement, the Australian Pig Society, the Royal Agricultural Society of N.S.W., the Rural Bank, the Commonwealth Development Bank and numerous country Show societies.

Eight pigs were supplied from the Hawkesbury Agricultural College herd to the Royal Prince Alfred Hospital, for a new technique involving pig livers in treatment of cases of liver failure in humans.

Pig Industry Production and Trends

Production by the industry remained very high throughout the twelve months, though pig-meat production showed only slight increase on the previous year's figures. This was because of a higher proportion of pigs slaughtered at lighter weights, for fresh pork. Pork consumption has risen to a high level.

Baconer production was barely adequate to meet demand with less production of this class of pig in N.S.W., and limited quantities from interstate and no supplies from New Zealand, some bacon-curing companies have considered developing their own piggeries. This has been done already in Victoria and Queensland.

Price levels continuing satisfactory have led to some complacency in the pig industry. History of the industry shows that the price structure is closely dependent on supply. With the high number of pigs slaughtered, a swing from porker (light weight) to baconer (heavy weight) production could cause havoc to prices. Again, if supplies of baconer carcasses were to come in notable quantity from interstate or New Zealand, regression in the price structure could be expected.

POULTRY SECTION

Extension Service

Activities Summary. The following summary indicates the extension activities of the Poultry Branch during the year:

Farms and Hatcheries visited	709
Field Days and Demonstrations attended/serviced ..	21
Visits to Government Institutions	49
Meetings attended/serviced	36
Articles to rural and industry press	13
Radio Broadcasts	8
Lectures and Symposia	30
Schools for Farmers serviced	2

Lack of experienced poultry extension officers in District positions limited the extension activities, but training programmes progressed satisfactorily and the situation is expected to improve. Positions in the North West and Southern Regions, and in the Gosford District, remained vacant. Full-scale extension activities were possible only in the County of Cumberland.

Duty Statements for two poultry livestock officers were altered, to provide for one to specialize in poultry meat production and the other in egg production.

"Poultry Notes". This quarterly periodical was produced regularly. Most of its articles received publicity throughout the industry.

Schools and Annual Field Day. Schools for poultry farmers were held at Hawkesbury Agricultural College and for turkey raisers at Wagga Agricultural College. The schools were well attended and covered all aspects of commercial production in the respective fields.

The Annual Poultry Industry Field Day, conducted at Hawkesbury Agricultural College, was highly successful. Several small group field days organized by the Poultry Branch were held at Seven Hills Poultry Research Station.

In-Service Training

Commonwealth, Poultry Officers' Refresher Course. The Poultry Section was responsible for execution of the Poultry Officers' Refresher Course, two weeks' duration, at Hawkesbury Agricultural College. The Course was organized on a Commonwealth basis, under approval from the Standing Committee on Agriculture. Attendance comprised 35 extension and research officers from all States.

Inter-State Study. One officer visited four other States to study controlled environment for poultry.

Conferences. Two officers attended the World's Poultry Science Association Convention. One attended also the Australian Chicken Meat Federation Conference.

Random Sample Tests

Random sample tests were conducted on egg producing stock at Hawkesbury Agricultural College and on turkeys at Wagga Agricultural College.

A commercial random sample meat-chicken test was not conducted this year through too few entries. Lack of entries is an effect of the degree of integration within the industry, and its present structure. As an alternative a non-competitive test has been organized, on similar lines to the normal random sample test.

Industry Trends

Egg production showed a general increase, and the trend towards fewer but larger commercial farms continued. The increase in production led to an increase in the C.E.M.A. tax. This at the 30th June, 1967, was 5 cents per bird per fortnight; 2.2 cents higher than at 12 months earlier.

Low prices (6-12 cents per lb) for culled hens continued. This encouraged some producers to vary the farm management practices. A number developed as specialist replacement pullet producers this year and the potential for this type of production increased.

The meat-chicken industry in New South Wales continued to expand. Statistics showed that production for the nine months to April 30th, 1967, was 26,270,000 birds slaughtered; compared to 18,979,000 in the nine months to April 30th, 1966.

Liveweight prices for chickens remained at 21.55 to 22 cents per lb and almost all birds were grown under contract to processors. Most contracts guaranteed growers a minimum return of 6 cents per live bird at market age, plus a bonus for efficient production. The return over the cost of feed and chickens averaged \$8 to \$10 per 100 birds.

Considerable interest was shown in the development of controlled environment shedding. Construction of a number of sheds incorporating this feature has started.

Turkey production also showed a significant increase. Statistics show that 340,000 birds were slaughtered in the nine months to 30th April, 1967; compared with 257,000 for the similar period ending 30th April, 1966.

APICULTURE SECTION

Extension Service

Officers of the Section participated in beekeepers' field days and meetings and conducted schools for beekeepers. Detailed attention was also given to apiary inspection work throughout the State.

The Department's Apiaries

Queen-bee Service. A record number of specially-selected queen bees was made available to apiarists, from the Hawkesbury Agricultural College Apiary.

The bee-breeding section of the College Apiary was further expanded to cater for increased demands from the industry for special breeding-stock. A grant of \$1,000 from the Australian Honey Board enabled the purchase of additional hive-equipment to increase production of selected stock.

Importation of Bees

The importation of queen bees was mainly from North America. All queen bees entering N.S.W. from overseas were cared for by the Apicultural Branch during the quarantine period.

Changes were made in the quarantine legislation, affecting importation of queen bees and escort bees into Australia. Bees may be imported now only from countries known to be free of internal mites; namely from U.S.A., Canada and New Zealand.

Industry Production and Trends

Lowered Production. Despite good rains this was a late season and the amount of honey produced was below average. The lower production was mainly because beekeepers had to build up their hive populations and restock many empty hives, depleted through the previous year's drought. By mid-summer many of these losses had been regained and beekeepers were able to gain a moderate yield of honey in the summer. Later in the season, autumn-flowering species such as blood-wood, greybox and coastal ti-tree yielded some good crops.

To build up hives to take advantage of the honey-producing flora, quite extensive moves from one area to another were necessary. This build-up then was greatly assisted by a record flowering of Paterson's curse, throughout central and southern districts. Thousands of hives were migrated to the Paterson's curse areas. These provided excellent breeding-conditions for the restocking of hives.

Markets. Despite low production of honey, prices did not advance to desirable levels. This was largely because of less overseas demand for Australian honey and also the satisfactory production in southern and western States. However, beekeepers were able to dispose of some of their crop on the home market, and this provided a higher return than did exported honey.

Bee Diseases

American brood disease was confined to small outbreaks, of which there were several, except in one case. This beekeeper erroneously attributed his loss of hives to the previous drought and took no control measures. Prompt action by the Section's officers prevented spread of any of the outbreaks.

DIVISION OF DAIRYING

General

OVERSEAS VISIT BY DIVISIONAL CHIEF

The Chief of Division of Dairying Mr D. W. Crowfoot returned in September, 1966, from overseas, having attended the International Dairy Congress and the International Dairy Federation Meeting in Munich, West Germany, and visited also the U.S.A., U.K., and France, Denmark, Sweden, Switzerland, Italy and Singapore. In these countries he enquired into farm production, processing, manufacturing and market-methods of milk and milk-products. He has since produced a comprehensive report. Copies of this are available from the Division of Dairying.

INDUSTRY TRENDS

The dairying industry in New South Wales is undergoing far-reaching changes. The move from farm cream-production, to whole-milk supply for manufacturing purposes, has gained momentum. Dairy-farm numbers have further declined, due to amalgamations and other land-use, but production per cow and per acre have increased.

The trend to whole-milk is accompanied by other changes: refrigerated, farm milk-storage; bulk-collection in tankers; and manufacture of diverse products instead of merely butter and cheese. The natural sequel to these changes is occurring—rationalization of production.

THE DIVISION'S ROLE

The Division of Dairying, consistent with industry trends, has been guiding both farm and manufacturing units, by planning, instruction, extension and research.

Supervision over milk and cream production on the farm and over dairy-produce factory operations has been maintained in accordance with the requirements of the Dairies Supervision Act, Dairy Industry Act, Pure Food Act and Shops and Factories Act. Administration of the Herd Production Improvement Scheme has continued. Farm projects have been conducted to assist quality control. Production has been improved through attention to better breeding and feeding of dairy cattle. Quality-surveys have been conducted. Research projects have been maintained and new projects initiated.

Thirty-one dairy officers were in the field. They aggregated 5,850 farm visits, and spent 7,162 hours in factories.

THE SEASON AND PRODUCTION

Despite dry conditions early, rainfall generally was above average in the dairying areas and there were floodings on the north coast. The stock-feed position has mostly been satisfactory. Production increased, as illustrated by the following year-comparisons.

	1965-66	1966-67	Increase
Milk	307,015,000 gal.	329,059,000 gal.	22,044,000 gal.
Butter	73,902,080 lb	(June 1967 estimate) 86,488,509 lb	12,585,422 lb
Cheese*	9,094,400 lb	11,231,360 lb	2,136,960 lb
Milk Powders (whole, skim, butter-milk, malted, coffee and milk, ice cream mix)	60,352,000 lb	75,804,000 lb	15,552,000 lb
Condensory Products (Concentrated, sweetened condensed and evaporated milk)	22,917,000 lb	25,940,000 lb	3,023,000 lb
Ice Cream and Frozen Milk Products	14,612,000 gal.	17,657,000 gal.	3,045,000 gal.
Cultured Products (Cottage and Ricotta Cheese and similar types)	697,609 lb	796,655 lb	99,046 lb
Yoghurt and Sour Cream	Figures not available; but increase estimated as 15 per cent in Metropolitan and Newcastle areas.		
Casein	Only one factory manufactures casein, and production-figures are not published; but output was up on previous years.		

* Cheese: Figures, supplied by Equalization Authority, do not include cheese made by non-members, nor all varieties.

DAIRY SCIENCE SCHOOLS

Ten Milk Grading and six Milk and Cream Testing and Cream Grading Dairy Science Schools were held throughout the State, to instruct and examine factory operatives and Dairy Technology students for qualification under the Dairy Industry Act. Examinations were held in Buttermaking and Cheese-making.

Examination	Candidates	Competency Certificates Issued
Milk Grading	102	63
Milk Testing	60	35
Cream Testing	66	42
Cream Grading	36	25
Cheese Making	14	13
Butter Making	35	32
	313	210

DAIRY TECHNOLOGY REFRESHER SCHOOLS

A Dairy Technology School was held at Finley, for all Dairy officers from the Parramatta, South Coast, Western and South Western Districts. Factory representatives also attended. The aim was to discuss new and improved equipment and machinery for milk-treatment, manufacture of dairy products, and problems. The talks were given by Departmental and industry personnel.

During this School, Dairy officers visited the Dairy Exhibition staged at Shepparton, Victoria, and also four Victorian factories to inspect factory construction and layout, equipment, and methods—including a recently installed continuous buttermaking machine.

A Refresher School for dairy factory operatives, held at the Hawkesbury School of Dairy Technology, was devoted to the operation, maintenance and servicing of different types of milk pasteurisers, and to laboratory-control tests and methods to ensure milk is adequately heat-treated in factories.

DEMONSTRATIONS OF ANTIBIOTICS-DETECTION IN MILK

Manufacturers had been notified by the Stock Foods and Medicines Board that as from 1st July, 1966, registrations would not be granted unless Brilliant Blue F.C.F. was used as a marker in certain antibiotics sold for use in udder infusion.

Arrangements by the Division of Dairying were made for a specialist milk-products officer and a dairy bacteriologist from Division of Science Services to demonstrate the anion-exchange resin-dye detection tests to dairy officers, veterinary officers, factory staffs and Milk Board supervisors. Twenty demonstrations were given at country centres, to an aggregate 357 persons. Demonstrations were also given at two Dairy Technology meetings, aggregating another 74 persons.

Most of the factories in N.S.W. receiving liquid milk now have the equipment for the dye-detection test.

Dairy-Farm Feed-Year Assistance-Scheme, North Coast

To operate for five years from 1st October, 1966, a Scheme was inaugurated by the Government to assist north coast dairy farmers who are outside the Milk Zone. Finance is available to the dairy farmer for partial reimbursement of costs of developing a "feed-year programme"; 50 per cent of the cost of seed, fertilizers, inoculum, and insect control materials—to a maximum of \$15 per acre and a maximum establishment-rate of 20 acres per year. For only the first year (1st October, 1966, to 30th September, 1967) an additional \$5 per acre was provided to defray costs on the area for which assistance was claimed in that year.

Eligible farmers are those who are registered dairymen under the Dairies Supervision Act; owner, or tenant farmer, or sharefarmer (on a farm registered under the Dairies Supervision Act) who is protected by a sharefarming agreement or covered by the Agricultural Holdings Act. The farm must be within the Shires of Macleay, Nambucca, Bellingen, Coff's

Harbour, Nymboida, Ulmarra, Maclean, Copmanhurst, Woodburn, Tomki, Kyogle, Terania, Gundarimba, Tintenbar, Byron, and Tweed; or traditionally a supplier to Dairy Produce Factories located in these areas.

The Scheme has been well received. By 30th June, 1967, after nine months' operation, applications by 3,142 farmers for assistance had been approved. The area involved was 59,286 acres. The amount paid in assistance for the period was already \$300,179, for 1,460 claims.

Results show increased farm-production; such that the largest factory-group on the north coast (Norco Ltd) reported the highest farm-average production in the last decade. Butter production-average per farm was 10,325 lb; 30 per cent above the average attained two years ago, before the drought.

Extension officers of the Division of Dairying have been closely involved in the Scheme as Chairmen of the District Committees, with the local District agronomist and a primary producer appointed by the Minister as co-members.

The overall administration is by the Regional Supervisor for North Coast Agricultural Region. He is Chairman of a Central Committee. This liaises with a Policy Committee located in Sydney.

Dairy Farm Improvement Competition

District dairy officers acted as district judges in the Country Life Dairy Farm Competition, and a senior dairy officer acted as State judge. Fifty-four entries were received and judged at district level. Ten of the farms qualified for State grading.

Officers of the Division of Dairying in co-operation with *Country Life* newspaper organized the competition and arranged itineraries for the State-judging party.

Commonwealth Dairy Industry Extension Grant

Funds allocated to Division of Dairying from this Grant have been used for the following purposes:

- (1) *Group Herd-recording*; portion of the cost.
- (2) *Purchase of I.R.M.A. Milk-Analyzer*; located at Hawkesbury Agricultural College.
- (3) *Milking-Machine Efficiency-Survey*; this year 1,606 machines were tested by six milking-machine survey-officers.

Results continue to prove that at least 80 per cent of the milking machines used in this State are inefficient. Use of perished and defective rubber-ware is still a major milk-quality problem. Faulty vacuum-regulators and under-capacity vacuum pumps are common causes of inefficiency.

One survey has disclosed that 20 per cent of the machines examined now have stainless-steel milk-lines.

Farmers who have fitted choked-squeeze attachments are pleased.

Despite recommended standards for milking-machine installations, and performances, too many firms installing them have tended to ignore them.

- (4) *Sire Survey*; the report has been incorporated under "Herd Production Improvement Scheme".
- (5) *Testing Station for Airflow Meters*; the report has been furnished under "Dairy Research".
- (6) *Farm Demonstrations*; the projects this year comprised: (a) continued operation of six water towers on farms, for milk-cooling; (b) continued operation of two water-treatment plants for dairy water-purification; (c) installation of three water-softening plants to overcome build-up of scale in milking machines; (d) continued use of concrete paths, constructed for cows leaving the cowbails, to overcome the bog problem. Each of these demonstrations has been successful.

Regulatory Services

REGISTRATIONS

Fewer Dairies—Increased Production

The total of dairymen supplying registered dairy-produce factories and milk depots continued to decline, while production continued to increase. There were 12,542 suppliers in 1965-66 and 11,700 in 1966-67; a reduction by 842 this year.

Factories and Stores

There have also been more store-registrations but a slight decline in factory-registrations.

Store-registrations increased by 33, from 121 to 154; factory-registrations decreased by three, from 106 to 103; three factory-registrations were cancelled; 120 wholesale stores have yet to be inspected for registration; one store-registration was cancelled and one was transferred; three registrations were varied, for manufacture of new products; and one prosecution was made, for unclean premises.

Plans and specifications were examined and approved for: *Dungog Co-op. Dairy Co.*, premises to house milk spray-drying plant and to store powder; *Tumut Co-op. Dairy Co.*, premises to receive/process/store market milk; *Producers Distributing Society (Sydney)*, extensive renovations and additions to existing premises for processing and storage of butter and cheese; *Brancourts Pty Ltd*, extensions to premises for manufacture of fancy cheeses; *Phillpot & Sons Pty Ltd*, new premises for manufacture of cooking margarine; and *Horlicks Pty Ltd (Nowra)*, alterations to premises for cheese manufacture.

Margarine Manufacturing Licences

Six licences have been issued for manufacture of table margarine for sale within Australia, and seven for export beyond the Commonwealth. Seven cooking margarine licences were also issued. Approval was granted for construction of a new factory to manufacture cooking margarine.

DAIRIES SUPERVISION ACT

Investigations have revealed many instances of unsatisfactory supervision of dairies registered under this Act, as administered by local Councils and in particular Shire Councils. The general standard of dairy premises is deteriorating. Short of adequate supervision, the position will further deteriorate.

Officers of the Department of Agriculture Division of Dairying have given technical advice as required; and jointly inspected dairy premises when requested by local Councils. The Division has also produced a new edition of the book *Dairy Farm Buildings*. This book incorporates design and plans; and provides general information on care of milk and cream, cleaning and sterilizing of milking machines and bulk milk tanks, a copy of The Dairies Supervision Act and Regulations, and directions for the guidance of Local Authorities, dairymen, and milk vendors.

DAIRY INDUSTRY ACT

District and Head Office personnel of the Division of Dairying have spent considerable time in general supervision of activities of dairy produce factories, to safeguard suppliers' interests and to ensure high standards of hygiene and efficiency in treatment and manufacture of dairy products.

Mechanization and automation of processing and manufacturing further increased. The Special Dairy Officer (Butter) continued to co-operate with factory management and District staff at Lismore; checking the efficiency of a continuous butter-making machine at the Norco Factory, Lismore, and a continuous butter-printing machine at Norco, North Sydney.

Dairy-produce store-registrations again increased. Approximately 120 stores have still to be inspected, to determine whether they should be registered under the Dairy Industry Act. In the main these are wholesale groceries but include some cheese-importers.

PURE FOOD ACT

Warning letters were forwarded to a number of farmers whose premises and utensils were unhygienic. Copies were sent to the appropriate Local Authority for the Dairies Supervision Act.

Special investigations were made at three factories by Head Office and District staff. The milk-grading standards were too lax. A directive was issued to the respective Manager and Graders, that poor-quality milk unfit for human consumption was to be second-graded or returned to the farmer.

FACTORIES AND SHOPS ACT

Liaison continued between District dairy officers and the Department of Labour and Industry officers in regard to requirements of the Factories and Shops Act affecting dairy produce factories. Each Department has informed the other of any changes in registrations.

Dairy-Products Gradings and Quality Investigations

BUTTER AND CHEESE

Grading Services. The Dairy Products Grading staff made regular examinations of butter and cheese manufactured by New South Wales factories; received in Sydney, Newcastle, Wollongong and Canberra for distribution and storage prior to sale on the local market.

Details of the grading were supplied to distributing agents, factory managers and District dairy officers. The information was basic in the quality-control and extension work done by the Division's field officers. Statistics of the grading were basic also for Order of Merit Certificates issued by the Department, and in assessing points for the R.A.S. Continuous Grading Competition.

Less butter and cheese were imported from other States than has been so in previous years, because of increased production here. At the request of the selling agents, quality of the interstate butter and cheese were checked by Departmental graders.

Approximately 1,380,000 boxes of butter from interstate and intrastate stores and approximately 3,400 samples of cheese were examined.

Other products such as powdered milk, butter oil, and margarine also were examined as requested from time to time by manufacturers and distributors.

Samples were regularly forwarded to Division of Science Services for biological examination. The results were sent to District dairy officers and factory managers, as were the results of regular analyses for moisture and salt content.

Special Quality Investigations. Special investigations in regard to quality defects were conducted at various factories, with co-operation from the Biology and Chemistry Branches.

Service as Judges. The grading officers were judges in the Dairy Produce Sections of the Sydney Royal Show, also the Newcastle Show, North Coast National and other country Shows. They also judged competitions sponsored by the N.S.W. Division of the Australian Institute of Dairy Factory Managers.

Surface-deterioration Trials. Further trials were done in connection with surface-deterioration of print butter and the use of various wrappings, including laminated foil and plastic-coated parchment. Reports of outcome were supplied to the industry.

Butter Quality-Control Surveys. Surveys of retail-butter quality were conducted in Sydney metropolitan and country areas, in the interest of consumers; 780 samples were subjected to sensory grading and biological and chemical analyses. Results were discussed with distributors and manufacturers with a view to preventing recurrence of any faults detected.

Cheddar Cheese Quality. The quality has deteriorated in areas where facilities are inadequate for treatment and control of milk quality. This is mainly so in small units where finance is lacking for adequate equipment and trained staff for laboratory-control of quality. Also in small factories, pasteurising units have not been competently/regularly serviced.

Factories are accepting milk of low quality for cheese-making, in the mistaken view that if the cheese is sold quickly it will be edible or alternatively suitable for cheese processing.

The Division of Dairying to prevent this trend is currently insisting on adequate sensory-grading standards for the milk, and factory-adoption of simple milk-tests such as the Methylene Blue Reductase, fermentation and sediment tests to assist the grader; any milk not reaching the required standard determined by these methods to be downgraded to second or rejected.

Some farmers' indiscriminate use of undyed antibiotics has aggravated the decline in quality.

Biological Survey of Cheese Quality. This survey is of the utmost importance. It is on a voluntary basis, done with factories prepared to co-operate. By means of it the unsatisfactory sensory-grading of milk, the neglect of simple tests, and the lack of regular servicing of pasteurisers were revealed. In all, 140 cheese samples were collected, from eleven factories.

Fancy Cheeses, Increasing Range. Gouda, Roman, Mozzarella, Ricotta, Fetta and Blue-veined cheese are being manufactured, in small quantities. A recent application from

Perfect Cheese Co. of Melbourne for registration to make Italian varieties has been approved, subject to construction of suitable premises. Increased manufacture of Italian and Continental varieties in this State can be expected.

OTHER MILK PRODUCTS

Manufacture of milk-powders, principally skim, has increased; for use in recombining-plants established in Asian countries by the Australian Dairy Produce Board. Manufacture of this type of powder has necessitated more stringent control over heating-processes to ensure satisfactory heat-stability of the powder after re-combining. As a result, casein manufacture is now limited to one factory.

Condensory-products and ice cream have also increased.

A number of factories also are making dried calf-starters, using skim and buttermilk combined with tallow or vegetable oils as a substitute for butterfat.

BULK-COLLECTION OF MILK

Milk-collection from farmers' refrigerated bulk-tanks continued to expand. Fewer cans are being received at factories. In general this has led to a change in milk-quality tests, so that the benefits of chilled-milk do not override the basic need of farm-hygienic milk-production.

Dairy Research Activities

(See Hawkesbury Agricultural College Report)

The dairy research activities conducted by this Division at Hawkesbury Agricultural College are reported in the College section of this Report of the Department (see page 144). The activities are sub-grouped as manufacture-research and husbandry-research.

THE NEW RESEARCH BUILDING—AND STAFFING

The new dairy-research building is nearing completion at Hawkesbury Agricultural College. It should be occupied towards the end of 1967. The facilities would enable expansion of the Research Group from seven to twelve, the staff needed as a minimum for effectiveness and continuity of projects.

Over recent years the research team has undergone much change of personnel. Only one of the present team has had more than two years' service. The six others range from almost-nil to two years' service. Four are under one year of service. Such staff-fluctuations in so small a team dislocate the entire programme and minimize the flow of effective results.

Appointment of a Principal Dairy Officer (Research) will take effect in September, 1967, *vice* the previous Principal (deceased). This should enable the team to re-develop into one of significance.

Work during the past year was further seriously dislocated through the section concerned with dairy manufacture research having to move into the School of Dairy Technology because of reconstruction of their previous, temporary premises in the Science Block

Solids-Not-Fat Recording (S.N.F.)

Two Experimental Solids-Not-Fat Recording Units

One is in the Parramatta District and one in the Nowra District. They continued satisfactorily. The herds at Hawkesbury Agricultural College, Wagga Agricultural College, Yanco Agricultural College and Research Station, and Grafton Agricultural Research Station are also in the project. The breeds are: Friesian (4,147), A.I.S. (1,792), Ayrshire (957), Guernsey (423) and Jersey (917). Both "grade" and pure-bred cows are included.

Collection of information began in April, 1961. During the last 12 months, data from 7,236 lactations were analysed by the Livestock Research Officer (Dairy Cattle).

The data analysed covered a period of 5 years and were for each separate year, for all years combined, and, where possible, for each breed individually, as well as for each district individually, and for all breeds and districts combined.

The lower permissible limit of S.N.F. used was 8.5 per cent, the lower legal limit permitted under the Pure Food Act. For butterfat, 3.4 per cent was used; an arbitrary value 0.2 per cent better than the limit set by the Pure Food Act. For Total Solids, 11.9 per cent was used; the result of adding 8.5 per cent S.N.F. and 3.4 per cent butterfat.

Preliminary analysis by the Chi-Square method, on the factors affecting S.N.F., has been completed. By this method the following factors were found to have a significant relationship to S.N.F. percentage, for all breeds:

- Percent butterfat.
- Percent Total Solids.
- Condition of cow at calving and any month of the lactation.
- Milk production of the cow (i.e., is the cow producing the average milk production for her breed—or better—or less than the average?).
- Disease.
- Age and Breed.
- Type of feeding (pasture alone, or pasture with roughage and concentrate, or no concentrates, or roughage in addition).

The S.N.F. percentage at any month of the lactation was related significantly to average S.N.F. per cent for the entire lactation. Thus, knowing the S.N.F. for any three-month period the S.N.F. for that cow for the entire lactation with accuracy could be predicted about 99 per cent of the time.

Month of calving was found to have no effect on S.N.F. per cent.

Regression analysis was begun on the factors shown by the Chi-Square analysis to have a significant effect on S.N.F. By regression analysis, factors so far shown to be significant are age, breed, butterfat and total solids. Further analyses are proceeding, on feedings and types of feed and condition of the cows.

Means calculated for each breed and age, for each individual year as well as the entire study-period of five years so far, reveal steady decline in percent S.N.F. and butterfat for all breeds as they age. Milk production shows a typical curve, rising until the cow is 7–8 years old and then falling.

The breeds highest in milk production in lb/day have been shown to be lowest in percent S.N.F. and percent butterfat; though they may produce more pounds of S.N.F. and butterfat because of their highest milk production.

Ranges were taken for S.N.F., butterfat and milk for all breeds for each age, and the mode (most popular value) and medians (value when 50 per cent total values on each side were calculated). In some cases the mode and median may give a truer picture, of what most cows of that breed are producing, but because of small samples are usually so scattered as to be statistically unreliable. The ranges and standard deviations (calculated for all breeds and ages, for each year as well as the entire period of five years so far) are more reliable.

The effect of season of year and stage of lactation on S.N.F., butterfat and milk production, for all the breeds, are now being analysed. It is hoped also to find, for the various breeds, butterfat levels whereat the farmer can select cows and most of the time raise the S.N.F.

The relationship of first-calving to percent S.N.F., percent butterfat and milk production, for the various breeds, was analysed. The results were ambiguous and often non-significant. There was a slight trend (for all breeds except Jersey) to improve percent S.N.F., percent butterfat and milk production as they calved at older ages (up to 3 years of age). Jerseys seemed to have better percent S.N.F., percent butterfat and milk production when they were calved slightly younger.

The relationship, to later production, of percent S.N.F., percent butterfat and milk production at first calving is also being analysed. This looks very promising.

To sum up, preliminary analyses by the Chi-Square method have been completed. Further analyses, into variations found by the first analysis to be affecting S.N.F., are being done by regression analysis. Also, the means for age and breed have been calculated and at this stage of lactation and season are being investigated.

SOLIDS-NOT-FAT RECORDING SCHEME FOR PURE BREDS

As mentioned in last year's report, from 1st July, 1966, a "pilot" S.N.F. recording scheme was started in the Nowra District, for Pure Bred Dairy Cattle only, on a bi-monthly basis; all calculations to be on the computer, and print-out sheets supplied to the farmers.

Forty-seven Pure-Bred Herds have joined this scheme. The original intention of showing the additional S.N.F. information on the one lactation statement proved impractical. The computer programme was therefore modified to (a) make all bi-monthly calculations backwards, and (b) provide a separate lactation statement for the S.N.F. data.

There was some difficulty in making these modifications, but the programme is now working satisfactorily. The first completed lactation statements were sent to farmers in early June, 1967. The information from this scheme is only for the guidance and information of the farmers and is "not certified".

Herd Production Improvement Schemes

HERD RECORDING

General

Staff. Two herd organizers were added to the staff. This restored the original ratio of one herd organizer to nine herd recorders in the field. The staff now comprises 91 herd recorders, 11 relief recorders, and 10 herd organizers.

Needed Expansion of Herd Recording Scheme. Two years ago a demand for ten additional Herd Recording Units was reported, and in spite of the severe drought in most dairying districts there was demand for nine Units one year ago. In the past year the demand for additional Recording Units has so increased that now an additional 18 Herd Recording Units are needed to provide this valuable service to dairy farmers who have indicated firm desire to join the scheme. They now see Herd Recording as a basic tool to provide information essential to increased efficiency.

Herd Recorders School of Instruction. In May, 1967, another successful school for herd recorders was held at Hawkesbury Agricultural College. This was the fifth since 1962, and marks the second year of the second round of the State's recorders.

Official Recording (Registered Dairy Cattle Only)

For the year ended 30th June, 1966 (the latest figures available) the total of herds recorded was 275; with 6,855 cows completing lactations of six months or over, including any cows exceeding the standard in a lesser period.

Butterfat production average was 321 lb, with 7,909 lb milk; satisfactory in view of the then still apparent effects of the prolonged drought.

Group Herd Recording (Grade and Pure-bred Dairy Cattle)

Cow Totals and Performances. For the year ended 30th June, 1966, the total of cows recorded was 86,275; 966 cows fewer than in 1964–65. This was a very good achievement in view of the effects of the drought. Some 70,371 cows completed lactations of six to 10 months, for an average of 5,540 lb milk (4.18 per cent test) and 231 lb butterfat (1 lb more than in the previous year).

Some 7,601 cows completed short lactations of from one to five months and averaged 2,100 lb milk (4.11 per cent test) and 86 lb fat. It is pleasing to note that this number of cows is 2,008 less than in the previous year.

The "all in" average for 77,972 cows completing lactations of from one to 10 months was 5,205 lb milk (4.18 per cent test) and 217 lb fat (3 lb higher than the previous year's result); very creditable in the circumstances. Part-lactation cows totalled 8,303.

Total of Herds Recorded. 1,521 herds were recorded in 91 Herd Recording Units; an average of 57 cows per herd. This compares with 1,543 herds, and an average of 57 per herd, in the previous year.

Inter-District Averages. For cows completing six to 10 months lactations the top three Districts were: *Orange District* (974 cows, 8160 lb milk, 3.63 per cent test, 296 lb fat), *Deniliquin District* (9,696 cows, 6,465 lb milk, 4.48 per cent test, 289 lb fat), and *Nowra District* (9,299 cows, 6,720 lb milk, 3.73 per cent test, 251 lb fat).

This was the same order as in the previous year. But the number of cows in Deniliquin District has increased from 8,330 to 9,696, making it the second from highest District in the State for number of cows completing lactations.

Highest Individual Recording Units. These were: *Unit No. 2*, in Deniliquin District, top of State with 1,039 cows and averaging 309 lb fat; *Unit No. 8*, in Deniliquin District, 2nd in State with 1,100 cows and averaging 307 lb fat; and *Unit No. 5*, in Deniliquin District, 3rd in State with 1,142 cows and averaging 303 lb fat.

Production in Relation to Length of Lactation. As cows milked for longer lactations, their production progressively increased. Cows averaging six months produced 143 lb fat, while cows averaging 10 months lactations averaged 281 lb fat.

The average length of lactation was 247 days, compared with 240 in the previous year; 34.1 per cent of the cows completed a lactation of 10 months and 90.2 per cent completed a lactation of six months or longer.

Production in Relation to Age Groups. The 4-9 years old age-group had the largest number of cows (42,896) with the highest butterfat average, 242 lb; the 2-year-olds averaged 203 lb fat; the 3-year-olds 218 lb fat; and 10-year and over group, 229 lb fat.

Month of Calvings in Relation to Production and Length of Lactation. The data, published for the first time, showed, in each of the 13 dairying Districts, the number of cows calving each month, the average pounds of milk and fat, the per cent of cows calving in that month for the District, and the average length of lactation for cows calving that month. The information is summarized for the whole State, showing:

- most cows calve during June, July, August, September and October;
- best production is by cows calving April, May, June, July and August (225, 227, 227, 229, and 231 lb fat, respectively);
- longest lactations are from those calving April, May, June and July (8.6 months);
- lowest production by cows calving in October, November, and December and January (200, 193, 198, 202 lb fat, respectively);
- length of lactation is shortest for calvings in October (7.7 months) and November (7.7 months), with December (7.9) the next from shortest, and January calvings showing 8 months as length of lactation.

Rule Changes—"Official" and "Group" Sections

In last year's Report, mention was made of some major rule-changes to operate from 1st July, 1966.

Changeover to general use of a 24-hour "check recording" for official herds, to follow on the normal 24-hour recording period, in place of the "strip out", has proved successful. The "strip out" provision is still in the rules, and used occasionally as required.

The increase in herd minimum-size from six cows to 15, with consequent increase in minimum fees for Official Recording, proved justified. No complaints have been received from farmers.

The adjustment to Group rules to eliminate Grade cows from access to the Register of Merit, and the elimination of the "Merit" marking of calves and Group Pedigree Recording, also proved justified. No complaint has been received from farmers.

Following on the Animal Production Committee's Australia-wide 1965-66 survey of Official Rules, 40 copies of this Department's new modified rules were forwarded this year to the Committee for use as a "model" towards the Committee's objective of uniformity. The Committee has given no subsequent indication of further action.

Official Recording—Computer Print-Out Sheets

As from 1st July, 1966, a new system of treating Official record sheets, as mentioned in last year's Report, was introduced. Difficulties in the early stages of the new system have been overcome. The system is now working smoothly.

Group-Recording Entry Forms

In co-operation with the Chief Biometrician and the Automatic Data Processing Officer, a new Group-Entry form has been designed, and printed. It ties in with provision of a group cow-history file on the computer magnetic tape; further simplifies the clerical work of Herd Recorders, and records cow information more accurately. The new form will be distributed in 1967-68.

Herd Recorders Certificate of Milk-Testing Competency

This year 20 Herd Recorders qualified for the Certificate; making a total of 48 during the last two years and a total of 146 since the first were issued in March, 1952.

A.D.P. Group Herd-Recording Data

All of the "old" Group herd-recording cards, covering the seven years from 1955-56 to 1961-62 (i.e., prior to computer processing of data) have now been read and the data have been taken to magnetic tape; a total of 343,215 cards.

Since the Automatic Data Processing system commenced in 1962-63, the Group lactations taken on tape have totalled 369,741; consisting of 70,281 for 1962-63, 70,404 for 1963-64, 87,241 for 1964-65, 86,275 for 1965-66 and 55,270 (as yet incomplete) for 1966-67.

CALF MARKING SCHEME

For the last two years wherefore the information has been collated, the details are: 1964-65—calves marked (i.e., tattoo-identified) 16,460, artificial insemination calves, 3,208; 1965-66—calves marked (i.e., tattoo-identified) 14,460, artificial insemination calves, 2,964. The grand totals since the start of the Calf Marking Scheme are: calves marked, 144,074; merit calves, 5,363 (to 30-6-66); artificial insemination calves, 15,271.

SIRE SURVEY

The method of Sire Survey remains unchanged from that reported last year. Two computer runs have been made; one of the complete 1965-66 data, and the other an interim run of the incomplete 1966-67 data—including Group Records up to December, 1966, and Official Records up to April, 1967.

In the Annual Survey (for 1965-66) over 7,000 bulls with daughters under record had surveys. Of these 1,200 had sufficient weight to be of value.

The Interim Survey is carried out specially for the Milk Board, concerned with use of artificial insemination. Latest information is thus available to farmers at the start of the breeding season. The interim run this year produced surveys on several of the younger "proving" bulls. It enabled some of the bulls to be discarded before the season started and others to be widely used.

This information was also included in printed handouts from the N.S.W. Artificial Breeding Centre Stand at the First National Dairy Exhibition, Shepparton, Victoria. There was keen interest there in the bulls available and in the method of Survey.

The Sire Survey's importance to dairymen was stressed by an extreme example in a press release this year. The example was provided by comparison of two A.I.S. bulls which had been used artificially; one a proven top animal, and the other proven extremely negative. Between the actual production-average of the respective daughters there was a difference of more than 3,000 lb of milk and 100 lb of butterfat, under uniform management conditions.

Government Herds (Stud)

PRODUCTION ACHIEVEMENTS

General. Production in all of the Government herds was generally well-maintained, although the two Grafton herds still showed some drought-effect on cattle completing lactations early in the year. The Wagga, Yanco, and Hawkesbury herds each exceeded 400 lb butterfat per cow.

Hawkesbury's Friesian Herd. This herd reached its highest production since formation; 48 cows averaged 12,872 lb milk (3.6 per cent test) and 464 lb butterfat. This gained for it the position of third from highest milk and butterfat producing herd in the State—for all breeds and irrespective of herd numbers.

Yanco; Top Guernsey Herd. The Yanco herd of Guernsey cattle was the top Guernsey herd in the State. The herd averaged 8,718 lb milk (5.0 per cent test) and 436 lb butterfat; 9 lb butterfat more than in the previous year.

The herd won the Newcombe Cup, as the herd with the six highest-producing cows. Six cows averaged 635 lb butterfat on a mature-equivalent basis.

Wagga's Jersey Herd. This herd returned to normal form, with a rise of 31 lb butterfat per cow over the previous year. The 42 cows averaged 8,125 lb milk (4.9 per cent test) and 402 lb butterfat.

Grafton's A.I.S. and Jersey Herds. The 34 A.I.S. cows averaged 8,967 lb milk (3.9 per cent test), 352 lb butterfat, and the 39 Jerseys averaged 6,894 lb milk (4.6 per cent test), 317 lb butterfat. These performances were slightly below those of 1964-65, explained in part by the poorer feed-conditions at Grafton, and the drought effect.

Six "Class Leaders". The Government herds provided six Class Leaders within breeds. These included "Wagga Empress Rose" and "Wagga Faithful Fay" in the Jersey breed, and "Yanco Roberts Twinkle" and "Yanco Karamas Sympathy" in the Guernsey breed. "Yanco Roberts Twinkle" was also the top All Breeds Junior Four Year Old for butterfat, with production of 608 lb butterfat.

COMPETITIVE, SHOW EXHIBIT RESULTS

Results at Sydney Royal Show were as favourable as in any past year. The Department's cattle were entered in 93 classes, and won ribbons in 45 classes.

Most successful was the Hawkesbury Agricultural College Friesian exhibit. It gained the "Most Successful Exhibitor" award in this Section. Another pleasing result was that the Wagga Jersey exhibit in very strong competition gained 3rd Prize ribbons in three separate classes for cows and 4th Prize for Cow with Best Udder.

Departmental teams also supported the North Coast National, Lismore, and other local Shows with success. At the North Coast National a team of A.I.S. from Grafton gained ten prizes, including Reserve Champion Cow and 2nd place for Best Uddered Cow by "Grafton Pride Maid".

At Grafton Show, the A.I.S. and Polled Jerseys were exhibited; at Penrith and Hawkesbury Shows, the Friesians; at Wagga, the Jerseys; and at Leeton, the Guernseys. Numerous ribbons were gained, including seven Championships, three Reserve Championships and four Supreme Championships.

As well as supporting the local Shows and demonstrating some of the Department's activities to the local people, the teams provided good experience for the College students in the handling of cattle.

SALE OF STOCK

Demands for both bulls and females remained at the previous year's very high level. In all, 126 animals were disposed of for Stud purposes in the eleven months since 1st July, 1966. Each Stud except Grafton has a waiting-list.

The special Royal Agricultural Society Show sales were supported by inclusion of eight animals of various breeds. Both the Friesian and Guernsey sales there were topped by Departmental bulls. Top prices were for "Hawkesbury Snow-drop King" (\$700) and "Yanco Twinkle Laddie" (\$500).

BULLS TO ARTIFICIAL-BREEDING CENTRES

Two bulls were forwarded to the Milk Board for artificial-breeding services. One of these, "Grafton Margarets Camera 4th", is the only A.I.S. bull in the N.S.W. Artificial-Breeding Services with a positive survey.

A further Friesian bull is being held at Hawkesbury Agricultural College pending inspection by the Bull Purchasing Committee.

This year, early artificial-breeding proof of one Departmental bull already in an artificial insemination centre has come to hand. The bull is "Hawkesbury Bonnie Voyager". It has a survey at this stage of R.G.V. milk 116 and fat 112. The type of cattle left by him is very pleasing, and heavy use of him can now be expected.

"Yanco Veras Champion 4th" has given a strong positive proof under natural service in Victoria. He is now undergoing health tests prior to inclusion in the Victorian Artificial-Breeding Service. This bull is the older brother from the same cow as two Yanco bulls in the N.S.W. service, and another brother is used with success in the Yanco herd.

The Department now owns 16 of the bulls in New South Wales Artificial-Breeding Centres; 24 per cent of the bull total. Two of the three premium bulls are Departmentally owned.

BREED SOCIETY CLASSIFICATIONS

Three of the Department's studs have taken part in Breed Society Classification during the year.

The Wagga herd was accidentally omitted from the normal Classification tour of the Jersey Society, but two of the Royal Show exhibits from this herd were submitted for special classification on the Sydney Showground. They were awarded V.H.C. classification.

Classification of the Grafton Poll Jersey herd resulted in excellent achievement; four V.H.C., 11 H.C., and three C. Classifications.

The Yanco herd was reclassified in the second tour of the Guernsey Society classifiers. The average classification of this herd has improved by 1.8 per cent since the previous visit. On this visit the herd achievements included one of the only two cows so far classified "excellent" in N.S.W., as well as eight "very good" and 10 "good" awards amongst the 31 cows classified.

PURCHASES OF STOCK

Funds for purchase of livestock were restricted. Only one animal, a Jersey bull for Wagga Agricultural College, was purchased. This was "Bemersyde Dream Jester", from Messrs G. & R. Cox, Murraydale, via Swan Hill, Victoria, for 750 guineas. This bull, excellently bred from the viewpoints of type and production, is from a proven sire and dam. He has a strong infusion of the line which was most successful in the old Yanco Jersey herd.

HERD ACTIVITIES

Poll Jersey Project

The number of poll females in this herd at Grafton, is now 80; a record. Type has improved, as demonstrated by the excellent classification-results already mentioned.

A further batch of semen, from the heterozygous bull "Grafton Gregory" has been stored at Graham Park Artificial Breeding Centre.

The breeding programme has centred largely around two proven homozygous bulls.

There have again been births of blind calves, reported early this project. This has not been definitely attributed to genetic causes, but this is likely since the whole of the poll factor stems from one heterozygous bull. Introduction of new blood, of poll nature, from some unrelated source is therefore desirable. Steps have been taken towards introduction of proven poll Jersey semen from New Zealand.

Miscellaneous

Development of research work at the Grafton and Yanco studs still awaits the appointment and training of suitable qualified research staff.

The Department has continued to provide mature bulls for semen-collection research at the University of Sydney.

Systematic recording of solids-not-fat production of all stud cattle under the Division's control continued. The data are now being analysed as part of the Division's solids-not-fat research.

The Division provided six sets of matched heifers for research at Wollongbar Agricultural Research Station.

Twelve calves from Grafton Agricultural Research Station were included in the DAN 12 parasite survey.

A number of animals from the Grafton herd were included in a liver-biopsy survey, to estimate copper deficiency in cattle at that Station.

Selected Friesian cows from the Hawkesbury Agricultural College demonstration herd have been mated to Brahan semen in the commencement of what may become a very useful and interesting piece of cross-breeding research at that College.

Nineteen stud A.I.S. animals were transferred to the Department of Prisons to form a new A.I.S. Stud at Emu Plains Training Centre.

Stud bulls were transferred to the Department of Child Welfare, for inclusion in the Berry Training Farm and the Mount Penang Training Farm studs.

A collection of growth and development data has been completed and now awaits analysis.

Sire assessment and the proving of young bulls inside the studs is continuing. The bulls measuring up to requirements are to be offered to the Milk Board for artificial-breeding work.



Controlled-environment plant-growth facilities in Biology Branch

Now installed in the Biology Branch, the facilities providing for plant-growth in controlled environments—including a section for separate temperature-control in root zones—have already been rewarding in studies of conditions affecting various fungal and virus diseases of crops.

DIVISION OF SCIENCE SERVICES

Biology Branch

GENERAL AND STAFF ITEMS

Staff

Dr Lilian Fraser attended the 4th Conference of the International Organization of Citrus Virologists held in Italy and Sicily during September-October, 1966. She presented three papers, including an invited review on the citrus tristeza virus complex.

On a post-session tour Dr Fraser studied the work in progress on virus and other diseases of citrus in Corsica, Spain and Morocco. Many of these diseases do not occur in Australia. The virus disease "stubborn", widespread in Morocco, and the fungus disease "mal secco" in Italy were of special interest. Dr Fraser by invitation also visited South Africa and was shown the citrus "greening" problem (virus) in the Transvaal.

Mr K. E. Hutton was seconded to the position of Executive Assistant to the Deputy Director-General (R.E.). Mr R. N. Allen and Mr A. M. Smith were awarded the degree of Master of Science in Agriculture of the University of Sydney. Mr R. D. Pares spent one month at the Biological Research Institute, Burnley, studying the electron microscopy and serology techniques of virus investigation.

Three members of staff are currently on post-graduate study leave: Mr A. M. Smith on two years study leave to University of Sydney, Mr R. Roughley at Rothamsted and Mr A. Robinson at the CSIRO Canberra.

Buildings and Equipment

Quarantine. Erection of quarantine glasshouses for the Federal Department of Public Health (plant quarantine) in the Rydalmere grounds has not yet started but organization has progressed.

Insect House. Work has started on the insect-house, to house cultures of insects for use in virus transmission.

Controlled-Environment Plant-Growth Cabinet. This is now in operation at Rydalmere with an effective growing-area of 37 square feet and a small section providing for separate temperature control of the root zone. It has already been of great value in the study of *Fusarium*-wilt of tomatoes, virus diseases of citrus, and maize mosaic; facilitating symptom development.

Plant Disease Conferences

Eleven of the Plant Pathologists attended the Australian Plant Pathology Conference in Queensland in November, 1966. Biology Branch members presented four invited review papers and contributed other papers.

Mr R. J. Conroy attended the First Australian Potato Agronomy Conference, in Victoria, and was subject-reviewer and discussion leader for the "Plant Protection—(a) Diseases" Session.

PLANT PATHOLOGY SECTION

New Plant Disease Records

Seventy-one plant diseases new to N.S.W. were recorded. Eleven were new host-records of *Meloidogyne* spp., the root knot nematodes.

Amongst the cereals and grasses, a particularly interesting occurrence was a leafspot, widespread, in young rice in the M.I.A. in November, 1966. *Cochliobolus sativus* (Ito and Kuribay) Drechs. ex Dastur, the fungus causing the spot, has been known for years as a common parasite of many cereals and grasses but had not been observed anywhere in the world attacking rice in the field. As the crops grew, the spotting disappeared. Subsequent growth and yield were little affected. Another of interest was *Fusarium* patch (*Fusarium nivale* (Fr.) Ces.) on the turf grasses, hybrid bent and Kentucky blue grass. It was also on winter grass, one of the most susceptible grasses in England and Europe.

In the north west, a safflower stem-anthrachnose caused by *Colletotrichum* sp. occurred in the spring of 1966. The exact identity, and relationship to species of *Colletotrichum* on other hosts, is being investigated.

Records on field and fodder crops included two fungus diseases on the tropical legume *Dolichos lab. lab* L. growing on the north coast. One was a zonate leaf spot caused by the *Ascochyta phaseolorum* Sacc. which has been recorded previously in New South Wales on French beans (*Phaseolus vulgaris* L.). The other was a leaf spot caused by a species of *Cercospora* resembling *C. canescens* Ell & Mart. The same fungus has been found in previous years, leaf-spotting other tropical legumes, and is one of the most common leaf-spot fungi found on these increasingly important plants on the north coast.

In vegetables the most serious new disease was mint rust, *Puccinia menthae* Pers. It was first recorded in a commercial planting of *Mentha spicata* L. at Glenorie during May, 1967. It has subsequently been seen at three other localities near

Sydney. Not all lines of mint being grown are susceptible. Further work on the disease is in progress. In potatoes, a tuber rot caused by the fungus *Phomopsis tuberivora* Gussow & Foster was seen at Crookwell. In parsnips a powdery mildew (*Oidium* sp.) caused some early autumn damage in the Murrumbidgee Irrigation Areas.

Associated with root- and wood-rots of stone fruit trees in the Murrumbidgee Irrigation Areas, various Basidiomycetes have been known for several years. This year, three of them were identified by Dr P. H. B. Talbot of the Waite Agricultural Research Institute and each represents a new host record for these fungi in New South Wales.

On ornamental plants, several new diseases were recorded. Downy mildew (*Peronospora parasitica* (Fr.) Fr.) of stocks was widespread in coastal districts, especially on seedlings. A cyst-forming nematode *Heterodera cacti* Fil. & Sch Stek 1941 was recorded on an ornamental cactus *Mammillaria carnea* Zucc. in a Sydney suburb. A leaf-curl fungus *Taphrina cerasi* (Fckl.) Sadebeck damaged flowering-cherry trees in a central tablelands nursery.

There were several new disease records on weeds and native plants.

The Biology Branch Herbarium (Dar)

Over 1,600 specimens were added to the Herbarium, bringing the total to over 19,000 specimens. Most of those added were of plant-parasitic fungi from New South Wales, but some were received from other Australian States or from overseas.

The Herbarium has been in constant reference use for information on identity and distribution of plant diseases. Specimens have been loaned to various workers and institutions.

Several collections of fungi were received for identification. Some were inquiries about edibility of various mushrooms. Some of the mushroom collections have been forwarded to overseas experts, for further knowledge here of the common species in N.S.W.

The Check List of Plant Diseases in N.S.W.

The bulk of the literature-work dealing with occurrence of plant diseases in New South Wales was completed. This has been card-indexed and the several thousand references filed in the Biology Branch Herbarium will form the basis of the literature-records entered in the Check List.

Systematic studies on several groups of plant-parasitic fungi continued, and two papers were published.

Several hundred collections of N.S.W. plant diseases have been examined, and collections lent by various overseas herbaria have been used in identification and systematic work. Preparation of the check-list manuscript for various groups continued.

Nematology Collection

Accessions in the nematology collection increased by 93, to a total of 388.

Aphelenchoides coffeae was collected from soil from Blacktown and cultured on mushroom mycelium (*Agaricus bisporus*) growing on agar. *A. composticola* occurred in compost from mushroom farms at Maroota, Bonnyrigg, Oakville, Lithgow and from Tasmania. Other species of *Aphelenchoides* found in mushroom compost were *A. limberi* and *A. martinii*; in small numbers. *Aphelenchus avenae* was collected from many widely-spaced places, including mushroom compost from Maroota and Oakville. *A. coffeae* and some of the populations of *Aphelenchus avenae* were used in an experiment on their effects on mushroom cropping.

Helicotylenchus dihystra was collected from 11 different localities. The only other species of *Helicotylenchus* found was *H. multicinctus*, in soil from lucerne.

The cactus cyst nematode *Heterodera cacti* was collected in N.S.W. for the first time. *H. schachtii* and *H. fici* are the only other *Heterodera* recorded in N.S.W. The important parasites *H. avenae* and *H. trifolii* have been recorded in other States.

Root knot nematodes *Meloidogyne* spp. were found on 20 different hosts, from 15 different localities. Eleven were new host records from the State.

Seinura oxura was collected from mushroom compost from Schofields, Maraylya and Marsden Park. Specimens of it failed to reproduce when placed on mushroom mycelium growing on agar.

Other spear-bearing nematodes collected included *Ditylenchus dipsaci*, *Neotylenchus* sp., *Pratylenchus coffeae*, *Rotylenchus* sp., *Scutellonema* spp., *Seinura winchesi*, *Trichodorus lobatus*, *T. minor*, *Tylenchorhynchus* spp., *Tylenchus semipenetrans* and *Xiphinema americanum*.

CEREAL DISEASES

Wheat Diseases

Barley Yellow Dwarf Virus. Work on this disease has been discontinued in the absence of the particular pathologist, on study leave.

Loose Smut (*Ustilago nuda*). Methods to control this disease in infected seed are being investigated. A method enabling large quantities of wheat seed to be efficiently and effectively treated is needed. Chemical seed-treatment, hot-water soaks and steam-air treatments are being compared. Results are not yet available.

Oat Diseases

Barley Yellow Dwarf Virus (BYDV). Natural BYDV infection occurred in oat varieties being used in loose-smut resistance trials. Field observations and recordings were made to see if oat varieties varied in their susceptibility. Results indicate that Avon shows greater field resistance, while Orient and Ballidu appear most susceptible. Observations are continuing.

Loose Smut (*Ustilago avenae*). Further trials using ten oat varieties and different smut strains, have been set up at Rydalmere. Each variety has been inoculated with three different combinations of smut strains. This is to sort out strain relationships and discover sources of resistance. Results of last year's trials were inconclusive. Incidence in artificially-inoculated seed was very low.

Maize Diseases

Maize Mosaic Virus. A new virus disease of maize has been recorded in the Tamworth region. Rydalmere studies revealed the cause to be a sap-transmissible virus. The virus was also in Johnson grass from Tamworth. It has been transmitted mechanically to other grasses, and to sorghum and pearl millet.

A virus disease of maize has been causing losses in many maize-growing areas of U.S.A. in recent years. There the virus infects Johnson grass, which enables survival of an alternative host between maize crops. The disease causes severe loss only where Johnson grass grows naturally.

Studies in the U.S.A. have shown the virus to be a severe strain of Sugarcane Mosaic Virus. The severe strain of the virus on maize has been called Maize Dwarf Mosaic Virus (MDMV).

Using facilities and assistance generously made available at the Burnley Plant Research Institute, Victoria, electron microscopy, purification and serology tests were done on this virus. It was compared with an isolate of Sugarcane Mosaic Virus present in N.S.W.

This work indicated that maize mosaic was distantly related to Sugarcane Mosaic Virus. Based on these tests the virus is considered to be very similar to the Maize Dwarf Mosaic currently subject of much investigation in the U.S.A.

Further serological work is being done, using antisera to the American isolates and comparing them with the N.S.W. isolates of the viruses.

Because the virus is so well established in native Johnson grass, control methods are difficult. They depend on finding resistant maize lines. Sixty-six maize lines from Grafton and Glen Innes Agricultural Research Stations and the Maize Growers Co-op., Grafton, are being screened for possible resistance to the virus.

Rice Diseases

Helminthosporium Leaf Spot. A leaf-spot disease appeared, widespread, in the Murrumbidgee Irrigation Areas and was found to be associated with *Helminthosporium* species. Since it could have been the blast disease (*Cochliobolus miyabeanus* (Ito & Kuribay) Drechs. ex Dastur), cultures of the fungus were forwarded to Dr M. B. Ellis at the Commonwealth Mycological Institute. He identified it as *C. sativus* (Ito & Kuribay) Drechs. ex Dastur. This seems the first record of the fungus as a parasite of rice. The course of the disease was closely followed by regular survey. It became less important as the plants developed and matured.

DISEASES OF FODDER AND PASTURE PLANTS

Vetch Diseases

The etiology of the serious root disease of vetch in the Richmond River district is still not fully defined. An unnamed virulent fungal pathogen, apparently a Phyco-omycete, infects plants in all stands on red basaltic soils and causes severe damage in paddocks which previously have been sown to vetch. *Pythium debaryanum* Hesse and a *Fusarium oxysporum* are important root invaders in some areas and considerably thin young stands.

The unnamed root pathogen also infects *Trifolium repens*, *T. pratense*, *T. subterraneanum*, *Medicago sativa*, *Glycine javanica* and all *Vicia* spp. accessioned in the Division of Plant Industry and the Commonwealth Plant Introduction Collections. Subterranean clover and glycine are only slightly susceptible but red clover and lucerne are severely affected.

Several fungicides have been glasshouse-tested but no satisfactory treatment has yet been found.

Lucerne Disease

Bacterial Wilt (*Corynebacterium insidiosum*). This is a serious disease limiting the life of lucerne stands, particularly under irrigation. Hunter River, the most common lucerne variety, is highly susceptible.

This year the disease was diagnosed for the first time in lucerne in several localities in Victoria. It might have been there for years. The organism's distribution is probably confined to specific areas by environmental conditions.

An extensive survey of N.S.W. lucerne-growing areas was done in 1966-67 to check for presence of the disease. District agronomists inspected many stands and submitted to Rydalmere any plant seeming to show field symptoms.

In all, 24 lucerne specimens from all parts of the State were received and examined for bacterial wilt. As yet this disease has not been found in any N.S.W. lucerne-growing area. Surveys are being continued and quarantine legislation has been introduced to safeguard the lucerne areas.

Grass Diseases

Spring Dead-Spot of Couch Grass. This was again the most serious disease of couch (*Cynodon dactylon* (L.) Pers) turf in N.S.W. From results of trials set up in 1965-66, control recommendations have been released. Provided the treatments are correctly timed, and properly done, complete control is possible. The results will greatly benefit bowling clubs and similar organizations throughout Australia.

Two fungicides, 80 per cent w/w thiram (TMTD) and 30 per cent w/v nabam, proved most effective; thiram at 4½ oz per 1,000 sq ft and nabam at 17 fluid oz per 1,000 sq ft. The fungicide is mixed with 30 gallons of water, applied to 1,000 sq ft of turf, and immediately washed in with another 30 gallons of water. This treatment should commence early in February and be repeated every four weeks until the end of September.

DISEASES OF VEGETABLE CROPS

Potato Diseases

Potato Seed Certification. Records compiled by Division of Plant Industry show that only one crop (3 acres) of those submitted for certification in the tableland areas was rejected because of excess virus-disease content. Purple-top wilt, caused by tomato big bud virus, was more prevalent than usual in the crops—because of predominantly dry conditions. But infections were insufficient for crop-rejections. High freedom from virus leaf-roll was maintained.

The Biology Branch in co-operation with Division of Plant Industry continued to check for virus diseases in crops being produced for elite seed at the Agricultural Research Station, Orange.

Late Blight (*Phytophthora infestans*). The disease was of very minor importance this year.

Co-operative work with Division of Plant Industry to produce potato varieties immune to race "O" was continued. Twenty-two seedlings derived from a blight-immune parent were tested. Of these, six were found to be immune; two of these were derived from the U.S. variety Kennebec, two from the seedling B595-76, one from Cherokee and one from Merri-mack.

Common Scab (*Streptomyces scabies*). Work in co-operation for development of scab-resistant potato varieties also continued.

Another predominately dry season on the central tablelands favoured heavy scab attack on susceptible varieties. The scab reaction of a number of early-maturing varieties and seedlings was assessed in a trial at the Research Station, Orange.

The rating for scab reaction was calculated, as in previous trials, on the severity of lesions and a scab index number (Maximum 4) was allocated for each variety or seedling. The scab index numbers obtained by average were: Shoshoni (a scab-resistant variety ex U.S.A.) 0.35; Cherokee (a scab-resistant variety ex U.S.A.) 1.025; S2897 (Redskin, scab resistant—natural pollination) 1.17; S2919 (B595-76 x Late Katahdin) 1.42; S2918 (B595-76 x 336-123) 1.91; E2908 (B595-76 x Adina) 1.99; and Exton (the susceptible control) 2.89.

Rugose Mosaic (Potato Virus X and Potato Virus Y). No advanced seedlings were submitted by the Division of Plant Industry this year for testing for field reaction to aphid-borne infection by Potato Virus Y.

Tomato Diseases

Fusarium Wilt (*Fusarium oxysporum* f. *lycopersici*) and **Verticillium Wilt** (*Verticillium dahliae*). Cultures of these fungi were supplied to the tomato breeders at Hawkesbury Agricultural College and Yanco Agricultural College and Research Station, for use in breeding resistant tomato varieties.

Results of a trial carried out on *Fusarium*-wilt and *Verticillium*-wilt infested soil at Long Jetty during the late winter and the spring of 1966 showed that plants of the lines VF36 x Rouge de Marmande (F1), VF206 x Rouge de Marmande (F1), VF145 x Rouge de Marmande (F1), Pearson VF11 and VF36 were free of *Fusarium*-wilt at the end trial, although a high proportion of Rouge de Marmande became infected.

Tests were done to determine the reaction to local isolates of *V. dahliae*, of a number of *Verticillium*-wilt resistant (VR) lines of established tomato varieties from the Summerland Research Station B.C., Canada. These VR lines of Marmande, Valiant, Stokesdale and Firesteel had been evolved by crossing the variety with Loran Blood and then undertaking a series of back crosses to the variety (Denby, L. G., and Wooliams, G. E., *Canad. J. Plant. Science* (1962) 42:681-685). A fifth *Verticillium*-wilt resistant variety, Summerdawn (Bounty x Loran Blood) *ibid* 42:380-381) was also included in the test.

Seedlings of the imported lines and also of the susceptible Rouge de Marmande were transplanted to pots of sterilized soil containing a mixture of six N.S.W. isolates of *V. dahliae*. The five Canadian lines showed high resistance in this test whereas the local Rouge de Marmande was highly susceptible.

This test, combined with the results of the Division of Plant Industry agronomic field-testing of the VR Marmande, VR Firesteel, VR Valiant and VR Stokesdale, will enable *Verticillium*-wilt resistant varieties soon to be available to growers. It will also enable VR Marmande and VR Valiant to replace Rouge de Marmande and Valiant in the production of hybrid tomatoes.

Cauliflower Disease

Club Root (*Plasmodiophora brassicae*). This disease of crucifers had assumed considerable importance in cauliflowers on the Macquarie River flats at Bathurst, following flooding in 1964. In the 1965-66 season some 50 per cent of the crop in this area was affected; 20 per cent affected severely. In co-operation with the Bathurst District agronomist a preliminary trial for control was done in 1966-67. Results of this trial indicated that lime application (½ ton/acre) and/or fungicidal treatment of the roots of transplants did not adequately control the disease. Further work is planned. Higher rates of lime will be applied to the soil, and new fungicides tested as transplant-root treatments.

Mint Disease

Mint Rust (*Puccinia menthae*). This was recorded for the first time in New South Wales, at Glenorie near Sydney, in May, 1967. It was heavy infection, in a ½-acre crop of *Mentha spicata* being grown for market.

A few plants of a round-leaved mint growing in the crop were not affected. Also, examination of plants of Stagger Weed (*Stachys arvensis*) growing near the mint crop did not reveal rust on them. Stagger weed is in the same botanical family (*Labiatae*) as mint.

Since this first record of mint rust in N.S.W., the disease has been recorded on *M. spicata* on four more occasions—at Mt Kuring-Gai, West Pennant Hills, Kellyville and Camden. Thus, it is established in the metropolitan and northern Illawarra areas. The susceptible *M. spicata* has been cultivated locally by one grower for 30-40 years without evidence of rust. Source of the infection is obscure.

The Asparagus Decline and Replant Problem

Pathology work on the asparagus decline and replant problem at Gundagai continued.

A further comparison was made, of the yield from a block of the *Fusarium*-tolerant strain of Mary Washington asparagus planted in old asparagus ground in 1963, with the yield of a comparable planting of the susceptible 500 W strain. The *Fusarium*-tolerant strain yielded 2,440 lb of spears per acre with 4.58 per cent culls. The 500 W strain yielded 2,516 lb per acre with 5.72 per cent culls.

Examination of samples from the two plantings showed more vigorous root-system and crown-development on the *Fusarium*-tolerant strain than on the 500 W strain. Also, infection of roots and crowns by *Fusarium* spp. was at this stage, much lighter on the tolerant strain than on the 500 W strain.

Seed of the *Fusarium*-tolerant strain, produced in a seedling block, is now being used to provide crowns for replanting an 85-acre block of asparagus.

Glasshouse-testing of seedlings from seed from surviving plants of 500 W in a replanted block continued. Some 20 lb of this seed was planted in glasshouse soil artificially inoculated with *Fusarium oxysporum*, *F. moniliforme* and *F. moniliforme* var *subglutinans*. Of the seedlings one was selected as showing high resistance. It is being grown-on and will be added to the collection of nine resistant seedlings from previous testing.

A further examination was made of plants from rows of 500 W asparagus replanted annually since 1962 on old asparagus ground. This ground had either lain fallow since 1962 or been planted to vegetables or laid down to pasture. In general, the same trend as observed in the 1966 examination was again evident. Earlier replantings showed more root- and crown-rot than more recent replantings, irrespective of rotation. Isolations from affected roots and crowns again showed more *F. oxysporum* and *F. moniliforme* var *subglutinans* than *F. moniliforme*.

Bean Diseases

Bean Seed Certification Scheme. Records compiled by Division of Plant Industry indicate that 12 crops (62 acres) were submitted for certification or approval. Three crops were rejected. One was because of halo blight (*Pseudomonas phaseolicola*), one was because of insufficient isolation, and the other was picked for green beans.

Root-Rot Complex of French Beans. This disease, discussed in previous reports, was less troublesome than usual. Seven recently introduced stringless varieties and two navy bean varieties remained healthy when exposed to natural infection at Yanco. These need to be observed again next year, because disease-incidence was low. Two of the stringless varieties are of good agronomic quality.

Rust of French Bean (*Uromyces appendiculatus*). A race of rust capable of attacking the varieties Redlands Greenleaf and Redlands Pioneer was mentioned in earlier reports. This race first appeared in Southern Queensland during 1964. It has been present for several years in N.S.W. northern coastal districts. During the 1967 autumn it was detected in specimens sent from the Sydney metropolitan area to the Queensland Department of Primary Industries to assist an Australia-wide study of races of French bean rust.

When inoculated under glasshouse conditions with the race of rust common in the Sydney metropolitan area, five advanced breeding lines and nine recently acquired varieties were found to be susceptible. One advanced-breeding line and one navy bean variety were resistant.

Angular Leaf Spot of French Bean (*Isariopsis griseola*). This was troublesome in some coastal areas during the 1967 autumn and winter.

Glasshouse inoculations showed that nine dwarf stringed varieties, 17 dwarf stringless varieties and 19 advanced breeding lines from the Department's plant breeders were susceptible. Fourteen lines showed varying degrees of resistance; including eight dry-bean varieties, three pole varieties, one dwarf stringed variety (Redlands Greenleaf) and two plant introductions, P.I. 150, 414 and Cornell 49-242.

Manganese Toxicity in French Beans. As indicated in the Chemistry Branch section of previous annual reports, this is a serious problem of winter beans in north coast districts. In Biology Branch co-operation with Chemistry Branch, preliminary glasshouse trials using both sand and soil culture have been set up to investigate possible differences in bean varietal-tolerances to high soil-manganese levels. As yet there is no significant result.

Stomatal Mechanism of Bean Leaves with Respect to the Physiology of Infection. A method of replicating plant surfaces has been investigated. A silicon rubber monomer is used to take a primary impression, and secondary transparent replicas are formed from this. These replicas are then examined with a light microscope, for convenient and accurate study of the morphology of the surface cells.

This method has been applied to the study of the stomatal response of leaves to changes in temperature and light intensity. The importance of these observations lies in the relationship of stomatal movements to infection by those pathogens which enter the plant by way of natural openings. The work is continuing.

Virus Diseases of Peas and Beans

Previous annual reports have mentioned a virus disease problem of pea crops on the central tablelands. Two aphid-borne viruses are involved, mainly pea top yellows virus and to a lesser extent pea mosaic virus.

Pea top yellows virus has also been referred to as bean leaf roll virus and it closely resembles or is identical with subterranean clover stunt. In the spring of 1967 this virus caused considerable losses in pea and French bean crops over a wide area of New South Wales, particularly in the near-Sydney area, the central and southern tablelands and in the western districts. The greater incidence was associated with unusually large numbers of one of the vectors, the Black cowpea aphid *Aphis craccivora*.

Some varieties of peas normally considered tolerant were severely affected. Two recently released French bean varieties are affected less severely than other varieties, but there is no satisfactory level of resistance in any of the present commercial varieties.

Onion Smut

The first outbreak of onion smut *Urocystis cepulae* in New South Wales was recorded in last year's report. The outbreak was in an old nursery at Blayney.

Quarantine action was taken to eradicate the fungus by formalin soil treatment on two separate occasions.

Laboratory testing of soil collected before treatment and after each fumigation showed: a high level of onion smut inoculum in the nursery soil before treatment, with 77.5 per cent of seedlings infected; the first treatment with formalin reduced the level of inoculum to 6.6 per cent of the seedlings infected; 8 per cent of seedlings were infected in soil fumigated twice.

MUSHROOM CULTURE AND MUSHROOM DISEASES

The commercial mushroom industry in New South Wales continued to operate satisfactorily. About 80 per cent of the crop is processed. The quality of mushroom spawn supplied by commercial spawn-producers remained satisfactory.

Diseases. The nematode *Aphelenchoides composticola* was found this year in compost in three localities in the Sydney metropolitan area, and also at Lithgow. *Aphelenchus avenae* was detected in small numbers in three composts in the Sydney metropolitan area.

Experiments with *Aphelenchoides bicaudatus*, isolated from soil, showed that infestation of compost by this nematode could significantly reduce yield of mushrooms.

Mat mould (*Myceliophthora lutea*) was recorded on three mushroom farms in the Sydney metropolitan area. It caused 30-40 per cent crop loss in one instance. On these farms peak-heating of compost was not practised.

A mushroom crop at Baulkham Hills suffered moderate loss through attack by a mildew fungus identified as *Diplocladium* sp. (similar to *D. majus*). This is the first record of a fungus of this genus causing losses in a commercial mushroom crop in New South Wales.

CITRUS DISEASES

Phytophthora citrophthora

Root-rot and Collar-rot Resistance Tests. Testing the *Poncirus trifoliata* accessions in the Departmental collection at Somersby continued. A further 129 accessions of *Poncirus trifoliata*, with two controls—rough lemon and rough lemon hybrid, Gran Erwin, were examined for their resistance to *Phytophthora* root-rot. Rough lemon and Gran Erwin roots were extensively infected but all trifoliata root-systems were highly resistant. A tetraploid (trifoliata 67), showed similar high-resistance to diploid strains.

The *Phytophthora* root-rot and collar-rot resistance of 118 Smooth Seville orange x trifoliata F1 hybrid seedlings were determined. Two of them developed severe root-rot but all of the others were highly resistant to *Phytophthora citrophthora*.

Use of aerated Hoagland's solution as the growing-medium for resistance-tests, and staining of roots with tetrazolium chloride to indicate the extent of root infection, have proved very satisfactory. In a preliminary trial, seven citrus types were compared. In decreasing order of root-rot resistance they were: *Poncirus trifoliata*, Troyer citrange, Ruby Blood sweet orange, Symons sweet orange, Smooth Seville, Israel Seville, and Rough lemon. Ruby Blood sweet orange is very susceptible to collar-rot infections but, for a sweet orange, has good resistance to root-rot.

Reactions to Collar-rot Inoculations. Of 25 selections of citrus tested for their reaction to collar inoculations, *Poncirus trifoliata*, *Severinia buxifolia*, and *Microcitrus australis* were highly resistant to infection. Scarlet mandarin and Cleopatra mandarin were less susceptible than the five selections of sweet orange used.

Saprophytism Studies. Studies on the saprophytism of *Phytophthora citrophthora* have shown appreciable invasion of dead organic matter (lucerne and wheat stems) especially under conditions of high soil moisture.

Chemotaxis of Zoospores. The chemotaxis of zoospores of *Phytophthora citrophthora* has been further studied. Attraction of zoospores to roots of susceptible and resistant varieties of citrus in the region of elongation or in areas where a wound has occurred was confirmed. Zoospores were similarly attracted to the roots of the non-hosts, bean and tomato. The areas of attraction coincide with the sites of excretion of ninhydrin-positive substances. Zoospores are also attracted to the ends of capillary tubes containing exudates or extracts of citrus roots.

Paper chromatography studies are in progress to determine the composition of exudates and extracts from *Poncirus trifoliata* and rough lemon roots.

Histopathology of Inoculated Roots. Histopathology of inoculated roots of susceptible and resistant varieties of citrus is being studied. Factors affecting zoospore release, motility and infection are also under examination.

Citrus Black Spot

The Black Spot (Guignardia citricarpa) Spray Experiment. This was continued on a 28-year-old block of Valencia orange trees at Mangrove Mountain. Again, seven fungicide-schedules were compared with the non-sprayed treatment in a 4-replicated randomized-block layout. Seasonal conditions proved unfavourable for crop production, and disease-incidence was light in the experimental block.

There was considerable variation in the degree of control obtained with three commercial formulations of copper oxychloride used at equivalent copper content (1.75 lb/100 gallons). All programmes gave good commercial-control and, generally, external fruit-quality was satisfactory.

In a combination programme of Bordeaux mixture (5-5-100) at petal fall, followed by two spray applications of antracol (2 lb/100- $\frac{1}{4}$ oil), at 6 and 13 weeks, fruit of outstanding quality was obtained.

External blemish of fruit was minimized by use of an alkyl resin wetting-agent in Bordeaux mixture applications at petal fall. Fruit appearance and rind colour were noticeably improved, compared with similar programmes where white oil (0.25 per cent) was used as a sticker.

Determinations of internal fruit-quality indicated juice-content of fruit sprayed with all the copper oxychloride formulations was higher than that of fruit sprayed with weak Bordeaux mixture-zineb programmes. Bordeaux mixture (5-5-100) followed by two applications of antracol (2 lb/100) resulted in higher juice-content than Bordeaux-zineb programmes, and fruit had a very thin rind.

In this year of light disease-incidence, a two-spray programme of copper oxychloride (3 $\frac{1}{4}$ lb/100 gallons) at petal fall, followed 10 weeks later by a single zineb application (2 $\frac{1}{2}$ lb/100 gallons- $\frac{1}{4}$ oil) gave black spot control equal to that of the three-spray programmes. External fruit-quality was satisfactory, but there was a slight reduction in juice content.

Supplementary Spray-Trial at Dooralong. Six combination programmes of Bordeaux mixture (5-5-100) with antracol and zineb were compared for disease control and effects on fruit quality. Fruit samples were collected on several dates throughout the ripening period.

In this trial all programmes gave good commercial-control of black spot and melanose diseases. Bordeaux mixture followed by two applications of antracol (2 lb/100 gallons) produced fruit with the thinnest rind and the highest juice-content (late in season), total soluble-solids content, and brix/acid ratio. However this programme also produced fruit with the lowest acid content. Bordeaux mixture followed by antracol (2 lb/100 gallons) and zineb (2 lb/100 gallons) produced fruit with the thickest skin, lowest juice content throughout the season and the lowest total soluble-solids content.

Spray Trial at the Research Station, Narara. Spray applications of gibberellic acid (15 ppm; 30 ppm) to immature Valencia fruits on 23rd November, 1966, were compared with benzyl adenine (10 ppm; 40 ppm) and controls. Assessment of black-spot incidence was made on the mature fruit the following season. There was no difference between treatments.

Fungicide Screening Trial at the Research Station, Narara. A three-spray programme of difolatan (2 lb/100 gallons) gave black-spot control comparable with a copper oxychloride three-spray programme. Dithane M45 (2 lb/100 gallons) and the experimental fungicide TD225 (Boots) proved unsatisfactory in controlling both melanose and black spot.

Brown Spot of Emperor Mandarin

Studies of Eradicator and Protectant Sprays. Studies were continued at the Horticultural Research Station, Narara, on eradicator and protectant sprays to control leaf and stem infections of brown spot (*Alternaria citri*) on young calamondin trees.

Commencing at petal-fall, tri-weekly applications of the following treatments were compared with an untreated control—(1) copper oxychloride (1 lb/100 gallons); (b) ZMC, the zinc, manganese, copper dithiocarbamate complex (2 lb/100 gallons); and (c) copper oxychloride (0.5 lb) + ZMC (1 lb/100 gallons). The final applications of nine sprays was made on 7th April, 1967. Prior to petal fall in August, half the plots received a single application of melprex at eradicator strength (4 lb/100 gallons).

Despite suitable weather for disease development little brown spot was observed in non-treated plots by the time the final spray application was made. Early in June, some leaf and twig lesions developed and an assessment was made a month later.

Unlike the previous season, melprex had no limiting effect on infections in the present trial.

The experimental dithiocarbamate ZMC failed to control stem infections but did provide some control of leaf infections.

The copper oxychloride programme provided the best protection. It reduced leaf infections from an average of 16.2 to 5.6 and stem infections from 40.0 to 15.0 per tree.

Virus Diseases of Citrus

Grapefruit Stem Pitting. In collaboration with Division of Horticulture, observations continued on the protection, under field conditions, given by mild strains of stem pitting against natural infection with severe strains.

An extensive planting of mild-strain propagations has been made at Narara. Severe strains of stem pit virus from various parts of the State have been freed from other viruses by aphid transmissions and will be used to inoculate the mild-strain trees in the autumn of 1968.

Scalybutt (Exocortis). Heat therapy of Etrog citrons and trifoliata seedlings infected with scalybutt was unsuccessful. Plants were kept at 100°C for eight months.

Psorosis. Indexing of all Departmental mother-trees is continuing. No positive trees were found last year.

Six-year-old Washington navel trees have been found with leaf symptoms of psorosis. Their origin is being checked. Between 30 and 40 trees of Old Mildura and Leng Navels have been found showing a variegated leaf-pattern and circular fruit-spots which become necrotic and sunken. These are being indexed for psorosis B. No similar condition has previously been found in these bud lines.

Heat-therapy, for eight months, of Surprise navels infected with psorosis, failed to eliminate the virus.

Xyloporosis. In collaboration with Division of Horticulture, all inoculated Orlando tangelos in the xyloporosis screening-trial of Departmental mother-trees at Somersby have been examined. One positive-tree was found and several suspect-trees. A few trees were showing creasing of the wood but were otherwise healthy.

Greening Virus and Stubborn. Trees in the major citrus-growing areas were surveyed for presence of greening and stubborn viruses, two diseases causing concern overseas. Budwood was collected from any suspect trees for indexing onto seedling indicators in the glasshouse and nursery-row trees.

Fruit was collected and paper chromatography studies were done on albedo extracts, in an attempt to detect the fluorescent substances reported (in South Africa) to be present in greening-affected material. Extracts made from fruit of suspect-trees have been sent to Dr A. Feldman of the University of Florida. He found, in many of the samples, the genetical glucoside which is responsible for the fluorescence. From his results, however, it seems that the genetical glucoside is not specific for greening or stubborn. It was found in albedo extracts from trees with severe stem pitting and exocortis.

Lemon Crinkly Leaf. Lemon crinkly leaf virus has been found in old lemon trees in two localities. No new case of infection in young trees has been observed. In each case the crinkly leaf symptoms have been accompanied by the psorosis leaf pattern, in bud-inoculated seedling indicator-plants.

Crinkly leaf virus has been mechanically transmitted from lemon to cowpeas (Black and Poona) and Eureka lemon seedlings.

Successful transmissions of crinkly leaf virus have been made from cowpea to cowpea but not from cowpea to citrus. Leaf-pieces were taken from the Eureka lemon mechanically inoculated with crinkly leaf, and placed into the stems of seedling Homosassa sweet oranges. After 12 days a psorosis oak-leaf pattern appeared.

These results suggest that either psorosis and crinkly leaf are strains of the same virus or that psorosis has been mechanically transmitted with crinkly leaf.

This is the first successful mechanical transmission of a citrus virus in N.S.W.

Controlled Environment for Symptom Production. Acquisition of a controlled-environment growth-cabinet has enabled citrus to be budded throughout the year, thereby facilitating the citrus-indexing programme. Very good symptom-development has occurred.

Stubby Root Disease

Changes in the number of *Trichodorus* in citrus beds at Narara following fumigation with vapam were studied over a period of 18 months. *Trichodorus* was eliminated by the treatment but was recovered within four months of fumigation, and its numbers increased during a period of 12 months whilst citrus seedlings were growing. After removal of the seedlings, *Trichodorus* numbers fell during a spring fallow, rose during the growth of a cover crop of cowpeas in late summer, and fell during the growth of a cover crop of field peas and oats in winter. The citrus seedlings grew satisfactorily.

These observations suggest that decreasing the number of *Trichodorus* present during the early life of the seedling permits normal seedling-growth.

In an inoculation experiment in pots, citrus seedlings were grown in sterilized Narara soil, with and without added *Trichodorus*. No conclusive result was obtained from this experiment.

Citrus Nutrition Research

In collaboration with the Chemistry Branch and the Division of Horticulture a nutritional trial has been continued at the Horticultural Research Station, Narara. The influence of various levels of nitrogen, potassium, calcium and magnesium on leaf-composition, fruit quality and yield, of Valencia oranges, are being examined.

DISEASES OF POME FRUIT

Virus Diseases of Pome Fruit

The transmission tests in progress at Narara for several years to determine whether certain growth-abnormalities were of virus nature were concluded without positive results. All plants were removed. This block and an adjacent area are to be used for routine indexing of recommended budwood-source trees, and for other investigational work on deciduous fruit-tree viruses.

The second season's results from the indexing of 12 Granny Smith budwood source trees and two selections of Northern Spy rootstock have been recorded. All trees were found to contain chlorotic leafspot virus, a common latent virus of apple.

The first season's observations on the re-indexing of eight Red Jonathan apples which had undergone heat-therapy treatment showed that seven were still infected by chlorotic leafspot virus. This virus can be eliminated by heat-treatment followed by tip propagation. Therefore it is thought the failure to eliminate the virus was because almost no growth was made by the plants during the heat-treatment.

The indicators inoculated from six selected Jonathan apples have been examined for one season. Results show that chlorotic leafspot virus is present in all but two of these.

During the indexing work over the past seasons, apple mosaic virus has not yet been detected in any of the trees indexed. Symptoms of this virus are not very pronounced at Rydalmere even on plants known to be infected. Therefore an experiment has been set up to determine whether climate, particularly temperature, is the reason for the failure to detect this virus at Rydalmere.

Another experiment has been commenced, at Narara, to determine the effect of apple mosaic virus on the growth of nursery trees and the effect of a previously unrecorded pear virus on the growth of nursery trees. Results will be available during the next two or three seasons.

Necessary buddings were done for indexing three apple rootstocks, nine recommended Delicious apple trees, and a Delicious apple from Orange showing symptoms thought to be due to a virus.

During the 1966-67 season a range of both pome and stone fruit virus and indicators which were inoculated with a previously unrecorded pear virus were regularly examined. None of the indicators has so far shown symptoms of virus infection. They will be kept under observation during the 1967-68 season. These symptomless indicators may be latent carriers of the virus.

The work of the Deciduous Fruit Tree Improvement Committee continued. Orchard surveys of recommended budwood-source trees of pome fruit resulted in the elimination of some from the list supplied to nurserymen. Replacement trees were selected where necessary.

Fungus Diseases of Pome Fruit

Apple Scab (*Venturia inaequalis*) **Incidence.** Conditions through the spring were conducive to scab infection in all highland districts. At Bilpin seven infection periods were recorded by mid-December. The most severe of these was of 156 hours duration, at an average temperature of 63°F, between October 13th and October 19th.

Scab Spray-Warning Services. These were conducted again at Orange and Batlow in association with the Division of Horticulture and radio stations.

Scab Control by Suppression of Inoculum. In a Maroota block of 60 Granny Smith trees which have received post-harvest sprays annually since 1955, the treatment was changed from organic mercury to 5 per cent urea. Infection was much heavier than in previous years.

In a field experiment at Bilpin, post-harvest pre-leaf-fall treatment of infected Granny Smith apple trees, with 5 per cent urea, affected a reduction in scab infection on the orchard trees and on small potted Granny Smith trees in the early infection periods in spring, of the order of 80 per cent. This was a smaller reduction than would be expected of a 0.1 per cent PMC spray, but the very dry winter may have reduced the effectiveness of the urea treatment. Further experiments have been commenced to compare the relative effectiveness of 5 per cent urea and 0.01 per cent PMC as post-harvest pre-leaf-fall sprays.

Mercury Distribution in Apple Trees After Post-Harvest Sprays. Further investigations have been made in co-operation with the Chemistry Branch. These confirmed that fruit from Granny Smith apple trees sprayed annually for ten years in the post-harvest pre-leaf-fall period with high concentrations of organic mercury fungicides for the suppression of apple scab inoculum, showed no evidence of accumulation of mercury. This was by comparison with fruit from trees known never to have been sprayed with mercury.

Bark-analyses revealed that mercury accumulated in or on the outer bark of the sprayed trees, and some mercury was detected in or on the bark of shallow roots.

There was no translocation of mercury to the bark of shoots formed in the season following the post-harvest pre-leaf fall treatment.

Phytotoxicity Investigation; Oil-Mercury at Green Tip. Further investigations at Orange in co-operation with Division of Horticulture revealed no detectable injury from green-tip or early spur-burst application of a mixture of PMC (0.01 per cent) and superior oil (3 per cent) to Granny Smith apple, Delicious apple, Williams pear, Packham's Triumph pear or Josephine pear trees. This combination for scab and mite or scale control has now been included in official spray recommendations.

Apple Mildew (*Podosphaeria leucotricha*) Epidemiology. In a study co-operative with the Division of Horticulture at Bathurst Agricultural Research Station, spore-trapping revealed a diurnal periodicity in conidial concentration in the orchard air. It may have a double peak. Processing of results is not yet complete but there appears to be a peak about mid-day and a lesser one at about 18.00 hours to 20.00 hours in the evening. The latter peak seems to coincide with the beginning of dew-formation.

After infection developed, the beginning of rain was accompanied by a very large and sudden increase in spore concentration in the air. This persisted for no more than one hour. Subsequent catches were generally very low, due either to the exhaustion of the supply of mature conidia or to "wash out" by the rain.

DISEASES OF STONE FRUIT

Virus Diseases of Stone Fruit

Trees involved in transmission tests of stone fruit growth-abnormalities have now been destroyed at Narara. The land is to be used for investigation of pome and stone fruit virus diseases.

The indexing of recommended stone fruit budwood-source trees has continued. Some interesting results have been obtained. The second season's results from indexing two Ron's Seedling cherries and five St Margaret cherries again showed prune dwarf virus to be present, as a latent virus. Also this virus has been detected during the first season's observations on suitable indicators inoculated with Early Lyons, Eagles Seedling and Florence cherries. These trees were all symptomless when examined in the field.

Several of these recommended cherries also caused an unusual reaction on Kwanzan flowering cherry, a standard virus-indicator, but it has not been possible to identify the virus causing the symptoms.

Two ornamental *Prunus* species showing virus-like symptoms were indexed on a complete range of stone fruit virus indicator hosts. Both plants were found to be affected by prune dwarf virus and each caused a "greasy sunken mottle reaction" on Elberta peach seedlings. This reaction is thought to be due to a virus usually occurring latently in apples. It has not been previously recorded in N.S.W.

Investigation of the cherry dieback on Mahaleb stocks continued. The workings necessary for an experimental programme have been done. The resulting trees are to be used for a statistically designed experiment to be planted at the Agricultural Research Station, Orange. In conjunction with the results from this work a programme of indexing some of the trees involved has been planned. This experimental work is being done in association with officers of the Division of Horticulture who are members of the Deciduous Fruit Tree Improvement Committee.

During March, 1967, budding of seedlings was completed for the indexing of three plum rootstocks, two cherries and five peaches on a complete range of indicator hosts.

An experiment has been set up to determine the effect of some viruses on the growth of stone fruit trees in the nursery. Results will be obtained from this work during the next two seasons.

The work of the Deciduous Fruit Tree Improvement Committee continued in regard to virus diseases of stone fruit, and orchard surveys of propagating material used by nurserymen were again carried out.

Fungus Diseases of Stone Fruit

Brown Rot Eradication Tests. A range of chemicals was tested for ability to eradicate overwintering infections of *Sclerotinia fructicola*.

The most effective was sodium arsenite (0.3 or 0.1 per cent), but it was highly phytotoxic to peach and apricot. Phenyl mercury chloride (0.1 per cent) was also highly effective but is an expensive spray. Its use could only be recommended in special circumstances.

Of the remaining materials tested, lime-sulphur plus oil was the most effective. It suppressed sporulation in spring by 70-90 per cent. This spray is recommended for winter application against several diseases and insect pests of stone fruit. Its value as a dormancy-period eradicator, against brown rot, had not been recognised.

Etiology of Brown Rot in Apricots. Strong evidence was obtained to support the view that over-wintering of *S. fructicola* in apricot trees is very slight, and that most of the inoculum in spring is derived from other stone fruits nearby. In the Murrumbidgee Irrigation Areas these are mainly peaches. The finding has important implications for the control procedures.

In other work on apricots the level of fruit rot was found to be closely related to the level of blossom blight.

Pre-harvest Protectants Against Brown Rot. A material claimed to be systemic was amongst the fungicides evaluated as pre-harvest protectants. Captan was the best material tested.

Rainfall Simulator Used. Many pre-harvest spray trials have not been productive in the past because rain is needed for assessment. In preliminary studies a rainfall simulator was used to overcome this problem. Results so far have been very promising.

Epidemiology of Brown Rot. Some work has continued on environmental factors in relation to sporulation, spore dispersal and spore germination and longevity.

Bacterial Diseases of Stone Fruit

Bacterial Canker (*Pseudomonas syringae*) of Cherries. Final results of a long-term experiment at Orange on the effect of height-of-working on bacterial canker severity in cherry trees were taken. This co-operative investigation with Division of Horticulture revealed that the "canker severity index" (length of canker x breadth) for stem infections on St Margaret cherry trees, budded just above the crotch on Malling F12/1 or Deister rootstocks, was significantly less than that for stem infections on St Margaret trees low-worked in the usual manner on Malling F12/1 rootstocks.

With the less-susceptible Ron's Seedling variety, similar comparisons revealed no statistical difference in "canker severity index". There was no significant difference in "canker severity index" for infections above the crotch in Ron's Seedlings or St Margaret.

It has been concluded that the canker-resistance of Malling F12/1 and of Deister, when used to form the stem and crotch of the tree, reduces the vulnerability of the highly susceptible St Margaret cherry.

Trunk-circumference measurements revealed that St Margaret trees high-worked on either Malling F12/1 or Deister had significantly larger stems than trees of the same variety low-worked on Malling F12/1. Ron's Seedling trees high-worked on Malling F12/1 had significantly larger stems than trees of that variety high-worked on Deister or low-worked on Malling F12/1.

DISEASES OF GRAPEVINES

Dead Arm in the M.I.A.

Wet conditions at and shortly after bud burst led to a severe outbreak on susceptible varieties in the M.I.A.

A trial has been started to examine the effect of spray-timing on control of dead arm, including whether fungicides applied at bud-burst will help. The trial will also compare a number of eradicator sprays with the recommended sodium arsenite.

Outbreak of Bunch-Stem Dieback

A severe outbreak occurred in all the grape-growing areas of the County of Cumberland; the first definite record of the condition in this area. In N.S.W. it has previously been known only around Orange and Molong on the central tablelands.

Severity varied in this outbreak in County Cumberland. Some growers lost three-quarters of their crop, and others lost very little. A slight incidence was reported late in the season from Orange.

The occurrence in County of Cumberland was in a season of above average rainfall following two seasons of below average rainfall.

DISEASES OF TROPICAL FRUITS

BANANA DISEASES

Black End (*Gloeosporium musarum*) and *Squirter* (*Nigrospora musae*). The relative inefficiency of dithane M45 in controlling banana black-end was apparent in the previous year. Therefore no further work has been done with this chemical for this purpose.

However, interest has been aroused by the observation of Division of Horticulture officers who have reported highly effective control of squirter and black-end by dipping the fruit in thiabendazole. The effectiveness has been supported by work in co-operation with officers of the Alstonville Tropical Fruit Research Station.

Preliminary results indicate that thiabendazole may be superior to salicylanilide or its sodium salt in the control of squirter disease. The work is continuing.

Use of thiabendazole for these purposes cannot be recommended before appropriate authorities have determined residue-tolerances and usage-conditions.

Passion Fruit *Fusarium Wilt*

Breeding-programme, for Resistance. In collaboration with the Division of Horticulture, the breeding-programme for resistance to *Fusarium oxysporum* f. *passiflorae*, by combining the field resistance of *Passiflora edulis* f. *flavicarpa* with the desirable agronomic characters of the black passion vine *P. edulis* was continued.

Selfed F₄ plants inoculated with *F. oxysporum* f. *passiflorae* have made satisfactory growth in infected soil at Kulnura. On the basis of disease resistance, and crop and fruit characters, a number of vines were selected and a number of flowers on these selections were selfed. Fruit is expected from the selfing programme, to continue the study.

STRAWBERRY DISEASES

Black Root Rot

Rotation Systems re the Disease. At Narara, an experiment is examining the effect of various rotation systems on black root-rot incidence and the effect on yield of fruit.

In plots which have now grown strawberries for four consecutive years black root-rot is severe. All plants exhibit stunting, and a bronzing and wilting of the older leaves. The few roots produced show the typical black root-rot.

In plots spelled for one year, plants have made good root-growth and had few blackened roots. In plots spelled for two years, plants had made very good root-growth and few plants had any blackened roots. In each of these cases the plants have made good leaf-growth and, even under very dry conditions, shown no bronzing and wilting of the older leaves.

Fruit-yields in the plots which have now grown strawberries for four consecutive years are only one-half of the yields of plots spelled for a year, and only two-fifths of the yields of plots spelled for two years. Increases in yield are greater when the ground is kept free of weeds during the spelling period. Also they are greater when a crop of soybean is grown in the rotation, than when a crop of cocksfoot is grown.

Virus Diseases of Strawberries

Heat Therapy. Heat-therapy of strawberry plants has been continued in an effort to produce virus-free plants of varieties universally infected with combinations of strawberry viruses. A total of 120 plants have now been treated and are still alive. Thirty of these have been found, by indexing, to be still infected with a virus or viruses. Indexing is not complete and may subsequently show more of the treated plants to be still virus-infected.

At least in two cases, one a plant of the variety Majestic treated for 49 days and the other a plant of the variety Richmond Red treated for 36 days, a very much milder combination of viruses is now present than was in the plant before treatment.

One plant of the variety Kendall, treated for 25 days, is still virus-free after two years. This plant has been propagated in a trial to compare it with a number of virus-infected clones of the same variety. In the first year the virus-free Kendall plants have produced one-third more saleable fruit than have plants infected with a mild combination of viruses, and almost three times as much as plants infected

with a severe combination of viruses. The average size of the fruit was about the same in virus-free and mild virus-infected plants, but somewhat smaller in the case of severe virus-infected plants. The latter produced a higher proportion of unsaleable fruit and very few large fruits.

DISEASES OF ORNAMENTALS

Petal Blight of Azaleas (*Ovulinia azaleae*). This fungus disease was severe in the summer. Several fungicides were used in a spraying-trial. The results were inconclusive. Incidence of the disease decreased in the controls as well as in the sprayed plants as autumn advanced.

Downy Mildew of Stock (*Peronospora parasitica*). This was recorded for the first time in the State in October, 1966. Since then it has been recorded several times from seedling nurseries in the metropolitan area, and Illawarra; also affecting more mature plants on the north coast and the north-western slopes. The pattern of distribution suggests seed-borne infection, but there is no proof of this.

The disease can cause severe damage, especially to seedlings. Control with fungicidal sprays is possible.

Phytophthora Root-rot of Conifers. Twenty-three ornamental varieties of conifers were tested for resistance to root-rot caused by the fungus *Phytophthora cinnamomi*. The root-rot is a major drawback to growing conifers in the metropolitan area.

In the first experiment, six varieties proved completely susceptible to the fungus and nine varieties were partially susceptible. Eight varieties appeared to be completely resistant.

Three isolates of the fungus were used for testing and, where varieties were only partially susceptible, differential susceptibility to isolates of the fungus was observed.

This work is continuing. Testing of susceptible varieties and others not tested so far, with further isolates of the fungus, is intended.

Aerated-steam Treatment of Seed. This work continued. Seed from two further families of plants, Leguminosae and Salomaceae have been treated. Their resistance to heat in relation to moisture content has been determined.

The results show that all seeds do not react in a similar fashion. Although most seed tolerate heat better when they have a low moisture content, excessive drying appears to decrease the survival of seed of some legume species.

Seed of China Aster (*Callistephus chinensis*) were successfully treated. Submission to 127°F for 30 minutes completely eliminated all seed-borne infection of *Botrytis cinerea* and *Alternaria tenuis*, and germination was not significantly affected by the treatment.

Biology Branch—Bacteriology Section

SOIL BACTERIOLOGY

This report includes results obtained by a member of the Biology Branch working under the guidance of Dr F. Gerger-sen at the CSIRO Laboratories, Canberra.

Root Nodule Bacteria

Host Effects on Soil Populations and Rhizosphere Populations of Clover- and Medic-Root Nodule Bacteria. A glass-house-experiment has been completed, using unsterile soil in which clover, lucerne and oats were grown separately and together.

Clover bacteria were recovered from the soil and rhizosphere of all the treatments. Large numbers of medic bacteria were found only in treatments growing lucerne. Inoculation with either clover bacteria or medic bacteria at planting increased the numbers of these bacteria for a short time afterwards but did not influence the soil-numbers or rhizosphere-numbers at harvest.

Using samples taken from the field, observations were made on the numbers of clover bacteria and medic bacteria, lucerne, and annual *Poa*. Clover bacteria were detected in all samples. By contrast, medic bacteria were found only in the soils and rhizospheres of lucerne and *Poa*.

If the striking behavioural-difference between free-living clover bacteria and medic bacteria demonstrated in both the pot trial and from field samplings is a general phenomena it may be relevant to legume-inoculation practices. Presumably: the low soil-populations of medic bacteria in the absence of a suitable host do not interfere with the establishment of applied inoculum—as when sowing inoculated lucerne; on the other hand, clover bacteria, less host-dependant, will exist in the soil in larger numbers and compete with the applied inoculum—particularly where the introduced hosts' *Rhizobium* requirements are critical.

Competition Between Effective and Ineffective Clover *Rhizobia* Strains. A technique has been developed to add mixed inocula of effective and ineffective *rhizobia* to a sterile test-plant, to study the progress of nodulation—including the formation of effective and ineffective nodules.

Eight effective/ineffective strain combinations have been added in about equal proportions to aseptically-grown subterranean clover plants (Tallarook variety). The effective strains produced the overwhelming majority of nodules.

In a second experiment, effective and ineffective strains were added in various proportions with each other. To form the majority of nodules the ineffective strain required a numerous advantage in excess of 10,000 : 1.

Whether these ineffective strains are merely inferior competitors, or whether the host exercised a selection-effect in favour of the effective organism, is not known. Nor is it known whether the host selects the effective strains in preference to strains of intermediate effectiveness. Work to elucidate this mechanism is continuing. It has important practical implications.

Effectiveness of *Rhizobium*-Nodulating Clover in Established Pastures. Over 300 isolates from clover plants growing in widely separated regions of southeast Australia have been tested for nitrogen-fixing ability. They have been compared with the recommended strain.

The mean level of effectiveness of the field isolates was only about 50 per cent of that of the recommended strain. This has obvious significance in respect of the need for inoculation.

Testing Commercial Legume Inoculants. Two surveys to determine the quality of legume-inoculants sold in New South Wales were conducted.

The survey for the testing of tropical species was only a limited one. Only 14 per cent failed to meet the standard required, as against 66 per cent in the previous year.

Two hundred and forty cultures for temperate legumes, purchased from retail stores, were tested. Improvement in quality of the inoculants was found. Only 8 per cent failed to meet the arbitrary standard, compared with 12½ per cent in the previous year.

Most cultures that failed to meet the standard were from the one manufacturer. Appropriate action was taken, and the quality of inoculants should continue to improve.

Growth and Survival of *Rhizobium* in Peat Culture. A dramatic improvement in both growth and survival of *rhizobia* in peat sterilized by gamma irradiation has previously been reported (Annual Report 1966). The results using the cowpea strain of *rhizobia* were particularly promising. It was decided to extend this project, using lucerne and clover strains.

When the supposedly-sterilized peat for this project was examined it was found to contain a large and diverse population of micro-organisms. This result was entirely unsuspected since the radiation dosage (10 megarads) used for the peat was far in excess of that required to ensure sterility of other materials.

Work to elucidate this problem will be continued in collaboration with the Officer-in-Charge of U-DALS, and with the co-operation of Lucas Heights Atomic Research Station.

DAIRY BACTERIOLOGY

Starter Cultures

The section continued to supply starter cultures for cheese, yoghurt and cultured buttermilk to the New South Wales dairy industry. This year, 1,661 starter cultures were supplied, about 500 more than in the previous year.

The number of requests for *Streptococcus lactis* and *Streptococcus cremoris* has declined. This may be due to two factors: (i) the standards of handling and propagating the cultures have risen, thus necessitating fewer requests for frozen-dried ampoules; (ii) a substantial number of South Coast cheese factories are using a commercial mixed-starter, and so are not getting cultures from this section.

Requests for yoghurt starters have increased. There are numerous requests from private individuals wishing to make yoghurt at home. The public has been advised to use a small portion of commercially-made yoghurt as a starter.

Butter Quality

Microbiological analysis of bulk butter (56 lb boxes) consigned from country factories to the central grading-floors in Sydney, Granville and Newcastle were done regularly during the main producing months (late September to the end of April).

As far as possible, a weekly sample was taken from each of the butter factories. A total of 701 butter samples were analysed for total-count, casein-digesting bacteria, yeasts and moulds, coliform bacteria and staphylococci.

The results have been sent through the Division of Dairying to the District dairy officers and Factory Managers, with comments on possible sources of contamination—and recommendations for improvement in factory hygiene, processing and handling of butter and cream.

Overall, the quality of the bulk butter has risen since the last survey. The analyses have now been conducted for ten years. Statistical analysis of these results is being considered.

The biological quality of retail print-butter in country areas was surveyed. It involved 82 samples. The results were sent to the Division of Dairying. This type of survey is designed to help processors, distributors and retailers, with advice on improved handling and sanitation methods in order to ensure highest keeping-quality of the butter.

Several surveys of butter processing plants were done. Samples were taken from each stage of processing, for microbiological analysis. As far as possible, one sample was followed through each mechanical operation. The results indicate areas where improvements could be made in the cleaning and sterilizing of equipment, and the hygiene of factory personnel.

Biological Quality of Cheese

The Section continued the bacteriological analyses of varieties of cheese produced in New South Wales. Cheese samples are tested for coliform and staphylococcal contamination. Overall, cheese quality has slightly declined since the last survey.

District dairy officers have been able to make good use of this information to point out to factory managers the sources of contamination. Where the quality is consistently poor, officers from this Section visit the factory in question, to advise the staff on improved production methods.

Antibiotics in Dairy Produce

The Stock Foods and Medicines Act, as from 1st July, 1966, requires penicillin and other antibiotics to contain a marker dye ("Brilliant Blue FCF"). Work was done last year to enable detection of the dye down to a level of 1/64 ppm by the use of resin absorption. This method, used as a modified sediment test, has been demonstrated over most of New South Wales, by officers of the Division of Dairying and this Section.

That the dye will be quite apparent in a milk can was demonstrated recently at the Erina Co-operative Cheese Factory. The suitability of other approved food dyes for antibiotic marking is being investigated.

Reports have been received from dairy farmers, veterinarians and District dairy officers to the effect that the use of high-potency antibiotic preparations has resulted in the presence of penicillin in milk from 8–20 days after the last treatment. Since the recommended time for exclusion of the milk of treated cows from the milk supply is three days, this has caused consternation among farmers and factories, especially where there are penalties for antibiotics in milk.

To resolve the problem, several high-potency preparations are being tested, in co-operation with the Glenfield Veterinary Research Station. This research is designed to determine the excretion times of such preparations.

Requests have been received for cultures of *Sarcina lutea* ATCC 9341, indicating that more interest is being shown in the detection of antibiotics in dairy products.

Other Bacteriological Services

Bacteriological defects in food products were investigated on behalf of commercial firms. Samples analyzed included yoghurt, goats milk, continental cheeses, water, and brine. Cheese quality at several N.S.W. factories has been sub-standard and has been investigated by bacteriological plant-surveys.

Officers of the Bacteriology Section attended the Australian Dairy Produce Board Research Seminar and the Dairy Factory Managers and Secretaries Annual Conference. An officer also

attended the Federal Council Meeting of the Australian Society of Dairy Technology, and has continued as a lecturer in Biology and Microbiology for the N.S.W. Dairy Apprenticeship Scheme.

Lectures and demonstrations on dairy products quality have been given at in-service schools for Departmental officers and for dairy factory operatives.

A regional bacteriology-laboratory was established at Lismore during the year, staffed by a qualified bacteriologist.



Ground-spraying to contain and control Plague Locusts

The rising cycle of Plague Locust activity towards the end of the 1965-66 season continued in the 1966 spring, with extensive infestation in several areas. See page 98 for an account of the outbreaks and aerial field-control activities. Many landholders contributed to the necessary campaign by ground-spraying

Entomology Branch

GENERAL

Retirement of Chief Entomologist

Mr P. C. Hely, Chief Entomologist, retired on 17th May, 1967, after 42 years of service. Mr G. Pasfield was appointed Chief Entomologist, and Dr G. J. Shanahan Senior Entomologist.

Overseas Study Tours

Mr B. M. Braithwaite visited New Zealand to inquire into control of pasture pests and avoidance of insecticide-residues, and development of equipment for application of chemicals to pastures. Mr M. Casimir visited major centres in the U.S.A., United Kingdom, and Africa concerned with locust research and control. Mr N. C. Lloyd is currently visiting entomological research institutions in Europe, Canada, U.S.A., and New Zealand, and integrated control of pests of pome fruits has high priority in his inquiries.

Dr G. J. Shanahan is visiting Europe, U.K., Canada, and U.S.A. to inquire into recent developments in insecticide resistance, as a possible aid to solution of the sheep blowfly insecticide-tolerance or resistance problems.

Entomologist to Narrabri

An entomologist has been transferred to Narrabri Agricultural Research Station to study pests of cotton, field crops and pastures in the north west.

PASTURE AND FIELD CROP PESTS

Australian Plague Locust

Spring Activity, 1966. The rising cycle of locust (*Chortolceetes terminifera*) activity towards the end of the 1965-66 season continued in spring, 1966, with extensive infestations in several areas. The main centre was in an area bounded by Hillston, Naradhan, Tullibigeal, and Ungarie. This area supported high-density nymph-infestations. Adults migrated in November, southeasterly, and large swarms invaded areas south to Ardlethan and east to Barmedman by the end of December. Other swarms were reported in the Riverina, north of Jerilderie, but whether these came from a separate source or were an extension of the main migration is not known. Heavy egg-laying occurred in the main infestation-areas.

There were many reports of less-intensive activity elsewhere. Loose swarms undertook short, drifting flights in the Dubbo, Coonamble, Molong, and Coonabarabran districts, central west. There were moderate to medium infestations in the Mudgee, Merriwa, Upper Hunter, and Denman-Singleton districts for the first time in many years. Lesser activity was also reported from the Tamworth, Narrabri, Moree, Warialda, Tenterfield, and Armidale districts in the north.

By the end of the first locust-generation the situation appeared serious over a very wide area. Large-scale hatchings occurred in January in parts of the Condobolin, Wagga, Narrandera, and Young districts. But very dry January and February conditions led to considerable dispersal of swarms and significant mortalities. Loosely-aggregated concentrations of adults, and scattered populations, were present over very wide areas by the end of February. The general rains early in March were followed by widespread egg-laying, so significant locust-activity in the spring of 1967 is expected. This

is especially so in the central west, but also to some extent in the Hunter Valley and the north west. Far-western surveys indicated no immediate threat from this area but there are pockets of infestation and these could provide swarming-populations later next season if favoured by conditions.

Aerial Field-control Trials. Several were carried out using the ultra-low volume technique of aerial application.

Technical malathion at 8.0 imp. fl. oz per acre effectively controlled later instar nymphs in the Yelkin area in November. The treatments were applied successfully without ground-markers or ground-direction. Trial spray-areas were defined by helicopter and the spray plane was directed by radio. Swathe-widths were judged by the spray pilot. This indicated the feasibility of aerial treatment of nymphal infestations without a large ground-staff to locate targets and to direct operations.

In December a large and dense flying-swarm near Ungarie was treated from the air with technical malathion. Results were excellent at a rate of 4.4 imp. fl. oz per acre but, since a moving target was being treated and the locusts flew into a specific area of treatment, the actual rate was probably closer to 15 fl. oz per acre. Results indicated about 200,000 locusts killed per gallon of malathion applied. A helicopter and ground-to-air radio greatly assisted the operation.

Aircraft-ability to operate for long periods, by applying ultra-low volumes of insecticide, greatly eased the organization-difficulties associated with aerial campaigns. Use of malathion in this way was recommended as an additional method in the standard aerial-campaign being carried out in the area. Several successful treatments resulted.

In many instances the loosely-swarmed nature of locusts made difficult the location and treatment of swarms for direct attack. Trials of a "bait-spraying" method, using timber lines or "baulks" in the path of locust flights, were carried out in February in the Wyalong-Ungarie-Burcher and the Tabbita-North Yalgogrin-Buddigower areas.

For the former, Wyalong-Ungarie-Burcher area, technical malathion was applied at 8.0 imp. fl. oz per acre. For the other area, fenitrothion at 4.4 fl. oz per acre was applied to suitable paddocks on the northern and western boundaries of timber barriers in hope of a good residual-kill of incoming locusts. Suitable "baulks" were first located and accurately mapped by the helicopter which also directed the spray plane to the targets.

Results indicated excellent kills in terms of outlay of insecticide; at least comparable with results from direct attack of dense flying-swarms.

Study of Phase Changes in Locusts. This study was continued. Several field samples were collected for measurement in the laboratory.

The Locust Patrol Officer. He made a number of surveys in the main infestation areas of the central west and a special survey of the western division in April. The usefulness of a helicopter was demonstrated, both for general survey purposes and for quantitative assessment of locust numbers by making direct counts of locusts flushed by the aircraft flown at low speed a few feet above the ground.

Quantitative assessments of the locust situation in the major outbreak areas have continued and are now being mapped for each locust generation.

White-Fringed Weevil

Widespread Activity. White-fringed weevil (*Graphognathus leucoloma*) activity both as larvae and adults was reported throughout the year, particularly on the mid-north coast. In spring, larvae caused widespread damage to lucerne, clovers and tropical legumes in the Macksville and Taree districts. Adults were reported in large numbers in late spring and to early autumn at Mudgee, Kyogle and Macksville. At Macksville the adults emerged in large numbers in late December and damaged the foliage of pasture legumes, whilst at Taree larval-damage was heavy in several lucerne stands. In the Kiama district larvae were reported attacking potatoes in April. Activity declined in autumn.

Field-control Trials. In a trial at Taree established in August, 1964, wherein aldrin, dieldrin and heptachlor each at 2 lb a.i. per acre, and ethyl parathion at 0.5 lb per acre, were sod-seeded and disced into the soil before sowings of *Dolichos lablab*, November, 1964, and lucerne, May, 1965, was re-sampled in December, 1966, and February, 1967.

In December, 1966, no larvae or damaged plants were recorded in the aldrin, dieldrin or heptachlor plots, but there were larvae and damaged plants in the ethyl parathion and control plots. In February, 1967, the position was much the same, but there were only about half as many lucerne plants in the ethyl parathion and control plots as were in the aldrin, dieldrin and heptachlor plots.

At Cowra and Canowindra, larval sampling was concluded in two long-term control experiments in lucerne.

At Cowra, larval numbers in soil treated with dieldrin at 1.5 lb a.i. per acre in August, 1959, before sowing to lucerne in September, 1959, were lower than in untreated soil when the regular annual observations were made in September, 1966. But they were low throughout the experimental area. The counts averaged 0.3 larvae per sq ft in treated and 0.9 per sq ft in untreated areas.

At Canowindra in soils treated at 0.9 lb and 2 lb a.i. dieldrin per acre in December, 1960, before sowing to lucerne in April, 1961, larval numbers were high in both areas when regular annual observations were made in September, 1966. The counts averaged more than 10 larvae per sq ft in each area and in a similar untreated area. They confirmed the previous year's observation that the two dieldrin treatments were losing their effectiveness.

The experiment suggested a five years' period of effectiveness for dieldrin, and that the 0.9 lb per acre rate is as effective as the 2 lb per acre rate.

Sitona Weevil

Widespread Damage. Damage by sitona weevil (*Sitona humeralis*) increased. There was a minor infestation in lucerne at Collector in August, 1966, but most outbreaks were in November and December. The most widespread damage was in the Leeton-Narrandera-Griffith district. Extensive areas of lucerne there were attacked during heatwave conditions. There were severe infestations at Gooloogong in November and in the Camden and Sydney metropolitan areas in October and November.

Insecticide Screening Trial. This was established at Carlingford in October, 1966. Seven insecticides, azinphos ethyl (2 oz and 4 oz a.i. per acre), DDT (8 oz and 16 oz a.i. per acre), malathion (8 oz a.i. per acre), bidrin (4 oz a.i. per acre), methidathion (4 oz a.i. per acre), fenitrothion (8 oz a.i. per acre) and dimethoate (8 oz a.i. per acre) were sprayed on to small plots with a knapsack sprayer. The best results at 48 hours were achieved with fenitrothion and both rates of azinphos ethyl. At five days a build up of weevils had occurred in all plots.

Clover Root Weevil

North Coast Activity. On the north coast the effects of winter-feeding by *Amnemus* larvae on the roots of subtropical legumes were evident in the spring in the slow growth of heavily infested stands. Adult emergences were substantial in summer but wet conditions throughout the period encouraged prolific growth of subtropical legumes and masked the effects of foliage-feeding. This contrasted with the two previous years when severe foliage damage was recorded under drought conditions. Mating and egg laying continued into May, in the very mild weather, and high larval populations in pastures were expected to occur in the approaching 1967 winter.

Field Control Investigations. There is a ban on dieldrin in pastures, except as an establishment treatment, because of residue hazards to stock. Therefore, control investigations were directed at determining the length of effect of pre-sowing dieldrin treatments, effective alternatives to dieldrin, and assessing promising legumes for resistance to clover root weevil.

The residual effectiveness of dieldrin at rates from 0.5-4 lb a.i. per acre, thoroughly incorporated into the soil before sowing subtropical legumes, is being investigated in three long-term field experiments. No results are yet available. None of the rate of dieldrin under test affected nodulation or germination of the test species, *Desmodium uncinatum* and *Glycine javanica*.

Laboratory Assessment of Insecticides. This is being done as a prelude to field testing promising materials. Insecticides are tested at rates of 1 and 4 lb a.i. per acre in pots, against fourth to sixth instar larvae. Larvae are exposed to treated soils at intervals of 2 and 8 weeks, to assess the contact and residual effectiveness of insecticides.

Insecticides tested include C.I.B.A. 10015, C.I.B.A. 8874, carbaryl, birlane, bromophos, dursban, endosulfan, methidathion, thionazin and fenitrothion. Birlane, dursban and endosulfan were effective at the 4 lb rate and are currently under

field test. Bromophos at 1 lb, birlane 1 lb and decolorone 1 lb a.i. per acre failed in field trials concluding during the year, but results suggested that decolorone should be assessed at a higher rate of application.

Study of Resistance to Amnemus. Lucerne and the subtropical legume *Lotononis bainesii* are the only commonly-grown perennial legumes on the north coast that appear to have natural resistance to clover root weevil. Siratro is seldom severely attacked and is not favoured in mixed subtropical-legume pastures which include *Glycine javanica* or *Desmodium* spp.

Screening of potentially useful legumes for resistance to clover root weevil was started this year in the North Coast Region. Twenty-one species or genera of legumes, some supplied by the CSIRO Division of Tropical Pastures, are under test at five sites in the Richmond-Tweed area. Adults and larvae of clover root weevil have been introduced to the experimental areas to aid natural infestation. *A. superciliaris* is the common local species at two sites and *A. quadrituberculatus* predominates at the other three.

Study of Amnemus Effect on Yield. A study of the effect of clover root weevil on yield of subtropical legumes was continued in a long-term experiment in the Richmond-Tweed area.

Survey of Subtropical Pasture Legume Pests

A survey of the insects occurring on the main species of subtropical legumes was continued on the north coast.

Clover root weevil (*Amnemus* spp.) was again the major pest of the important subtropical legumes, *Glycine javanica*, *Desmodium uncinatum* and *D. intortum*. Larvae were very damaging to roots of all three species in the July to October period and delayed the spring growth of heavily infested pastures. Adult weevils were numerous on foliage from December to May, but good rainfall throughout the period favoured legume growth and with minor exceptions little leaf damage occurred. The position was quite different from the previous two seasons when pastures made little headway under drought conditions and were continuously defoliated by adult weevils.

White-fringed weevil (*Graphognathus leucoloma*) was recorded for the first time attacking *Lotononis bainesii*. Larvae feeding on the roots killed plants in a small section of a large sowing at Byrill Creek, Tweed River, in October.

Third instar larvae of pasture white grub (*Rhopaea magnicornis*) severely damaged the roots of *D. uncinatum* and *G. javanica* at Dorrroughby, Richmond River, in July and August. The infestations were in second year pastures where ground cover was incomplete. The larvae made large shallow furrows and occasionally severed the roots.

Adult green scarab beetles (*Diphucephala lineata*) severely damaged the foliage of *D. intortum* in a pasture containing a number of other species of subtropical legumes at Tweed Heads, October.

Armyworms and Cutworms, Noctuidae

Incidences. Severe armyworm outbreaks occurred on pastures and field crops. The most serious were on the north and central coasts, northern tablelands and in the Murrumbidgee Irrigation Area.

Outbreaks of *Pseudaletia convecta* were widespread in the Nepean/Hawkesbury and the Coraki districts in late summer and autumn. Scattered, small outbreaks occurred in other coastal areas. In summer, there were big outbreaks on crops in the Inverell district and on rice in the Griffith district. A single outbreak of *Persectania dyscrita* occurred at Lake Cargelligo in pastures in August.

Intensive Field-studies. The outbreaks in the Nepean/Hawkesbury and the Coraki districts were studied intensively. In the Nepean/Hawkesbury district the outbreak commenced in late February after heavy rains and reached its peak in mid-March. Larval numbers declined rapidly towards the end of March because of pupation, virus disease and parasites. A wide range of hosts, mainly grasses, were attacked and the following seriously damaged: sudax, paspalum, oats, maize, couch, ryegrass, kikuyu, and summer grass. Occasionally broadleaved-plants were eaten, but this was generally after the grass components had been removed. Most larvae were 4th-6th instar and dark-brown to black. Numbers ranged from 5-10 per sq ft to 30-50 per sq ft in pasture and 1-10 per sq ft in crops.

In the Coraki district, armyworm infestations followed widespread flooding in late March. They became obvious about 16th April and by 23rd had attacked about 10,000 acres of paspalum and kikuyu pastures. In most areas the larvae were dark-brown to black 4th-6th instar larvae and moved actively towards unflooded areas. Numbers ranged from 10-30 per sq ft. Populations declined towards the end of April.

Egg-laying and Longevity Studies. Studies of adult *P. convecta* showed that females had a pre-ovipositional period of 4.80 days and lived for 11.60 days. The longevity of males was 12.43 days. The mean number of eggs per female was 841 with a range 0-1627. The highest percentage of eggs was laid between the 5th and 8th days after emergence.

Addition of protein to the diet of adults reduced their pre-ovipositional periods and longevity, and increased the mean number of eggs per female and the number of days on which oviposition occurred.

Experiments on Effects of Low Temperature. Using first instar larvae of *P. convecta*, experiments indicated that larvae can survive up to 8 days at 40°F without apparent harm. With immersion, however, larval mortality increased rapidly after 24 hours. Eggs which were immersed for more than 48 hours did not hatch. The effects of temperature and humidity on the various stages of *P. convecta* are currently being investigated.

Host-preference Studies. Laboratory studies showed that wheat, maize, and barley are preferred to oats by fourth and final instar larvae of *P. convecta*. No significant feeding-preferences were found, as between varieties of wheat and oats. Forty-seven species of Gramineae, four species of Cyperaceae, a species of Restionaceae and 14 species of dicotyledonous plants have been recorded as hosts of *P. convecta* in the field.

Parasites. Twelve species of parasites, eight predators and two diseases were this year identified attacking *P. convecta*. The three most common parasites were *Netelia productus*, *Lissopimpla excelsa* and an unidentified Braconid.

Larval Taxonomy. Studies of the principal armyworm genera are continuing.

Red-Legged Earth Mite

Incidence. Red-legged earth mites (*Halotydeus destructor*) were present throughout the south and central western areas in winter, but declined in mid-spring with the onset of warmer weather. Because of an abnormal weather pattern, the damage-period appeared later than usual. Dry conditions with poor opening-rains in the autumn of 1967 delayed the hatching of overwintering eggs. Mite-reports were few and no serious damage occurred in autumn.

Field-control Trial. A trial comparing malathion by ultra-low volume application with imidan was established at Darling Point in June, 1966. Technical malathion was aerially-applied at 4 oz weight per acre and imidan was boom-sprayed at $\frac{1}{2}$ oz a.i. per acre. After 33 days no difference was apparent between treatments. At 56 days imidan was giving slightly better control than was malathion.

Blue Oat Mite

Increased Severity. The weather pattern in the winter and spring of 1966 increased the severity of blue oat mite (*Penthaleus major*) infestation of fodder and cereal crops. Widespread and heavy infestations were reported from the tablelands and central and northern slopes. The mite attacked grazing-oats and wheat. Oats was more severely damaged than wheat.

On the tablelands, where heavy mite populations were associated with heavy frosts, large areas of grazing-oats were bleached and had to be sprayed. In the wheat areas the attack was less severe but aggravated by dry conditions.

There were several reports of damage on improved pasture in the Taree district. Hatching was delayed in autumn because of abnormally warm weather and lack of autumn rains, and by June only areas which had reasonable falls of rain reported mites.

Field-control Trials. In July, 1966, a trial to test alternatives to DDT was established on wheat at Bathurst. Imidan, phorate, and methidathion at $\frac{1}{2}$ oz a.i. per acre, and DDT at four rates ($\frac{1}{2}$, $\frac{1}{4}$, 1, and 2 oz a.i. per acre) were applied to plots by a "lo-vol" boom-spray. After 23 days, DDT at the four rates and imidan were more effective than the others. At 40 days, DDT at 1 and 2 oz a.i. per acre and imidan were still effective.

A second trial was established in July, to compare malathion at ultra-low volume application with imidan; malathion applied at 4 oz weight per acre with a modified misting-machine, and imidan with a "low volume" boom-sprayer at $\frac{1}{2}$ oz a.i. per acre. Throughout, imidan was satisfactory but malathion was ineffective.

A seed-treatment trial using dimethoate, formothion, and Du Pont 1179 was established at Oberon in March. Oats seed was coated with each of the three insecticides and sown with a combine into a prepared seed-bed. Delayed mite-holdings have prevented assessment so far.

Another trial was established in March to assess the effect on crop-productivity of spraying DDT at 2 oz a.i. per acre at 2-monthly intervals. Delayed mite-hatchings have so far prevented assessment of this trial also.

Survey of Red-Legged Earth Mite and Blue Oat Mite

Because of differences between the two species a State-wide survey of the distribution, host range and economic importance of each was started in 1966.

During the latter half of 1966, three surveys along major highways were undertaken. Red-legged earth mite appears to be confined to the southwest slopes, the western half of the southern tablelands and the southern half of the central west, whereas blue oat mite occurs throughout the State east of the western limit of the wheat belt. However, economic populations of blue oat mite have only been found in the northern half of the State and on the south coast and southern tablelands. In the southwest there are only occasional blue oat mites. A large number of hosts of both species have been found.

Seed-Harvesting Ants

Effect on Pasture-establishment. A project was initiated to examine the role of pasture ants (*Pheidole* spp.) in the establishment of surface-seeded pastures and to investigate means of preventing seed-theft in central and southern tablelands pastures. Observations on the field-behaviour of seed-harvesting ants were made at Bathurst and Rydalmere. Preliminary tests were made of the ant-repellent value of various chemicals, especially when used as seed dressings.

Incidence. Black Beetle (*Heteronychus arator*) damage occurred in many coastal areas, through over-wintering of a big adult population. Maize was the main crop affected. Damage occurred in spring and later summer on the south and far south coast, and in the north at Kyogle and along the Manning and Tweed Rivers. Tomatoes were attacked in October and some turnip and oat crops were destroyed in April in the Manning district. Potatoes were damaged in October in the Clarence district.

Pasture damage was recorded in some Hunter River and central coast areas seriously affected by drought the previous season; especially at Maitland in October, and on the Manning and Wallamba Rivers in February. Beetles were reported more prevalent than ever before in the Gloucester area. Damage in the Manning district included the destruction of established ryegrass in sown pastures, by the larval stage. In north coast areas the beetles were numerous in January and February and some swarming occurred.

Insecticide-screening. Investigations of the value of insecticides of low mammalian-toxicity were commenced. Results with activated pyrethrins against adult beetles were promising and may justify field-testing.

Cotton Insects

Range, Incidence and Field-control. The main cotton-pests returned to about normal numbers after the drought broke in early October, 1966. Recommended control measures continued to give satisfactory results.

Of the seedling pests, cowpea aphids (*Aphis craccivora*) were noted only in the very early-sown crops, but no control measure was necessary.

Three different species of caterpillars attacked the cotyledons but the damage was unimportant.

Thrips (*Thrips tabaci*) damage appeared early and continued slightly longer than usual.

Cotton tipworm (*Crociosema plebeiana*) was patchily distributed in some crops around Wee Waa in December.

Common bollworm (*Heliothis punctigera*) was again very severe. Infestation started as usual at the squaring-stage and continued for about six weeks during the main flowering period and until the main crop of bolls had been set and held. DDT sprays at 5-day intervals were needed to prevent losses during this critical period.

Tobacco looper (*Plusia argentifera*) damaged foliage from late January. By mid-March it was severe in some of the more backward crops west of Wee Waa. Schedules of DDT plus toxaphene gave the best control while DDT plus endrin was also satisfactory. Where knockdown-sprays had become necessary, mevinphos was most effective, while methyl parathion and naled also gave acceptable control. A fungus caused an epizootic among the caterpillars late in March and the need to use insecticides ceased. Sporangia found on some specimen-caterpillars will enable specific determination of the fungus (*Entomophthora* sp.).

Spider mite (*Tetranychus ludeni*) infestations first appeared in mid-January. They were effectively controlled by one or occasionally two inclusions of a specific miticide in the *Heliothis* spraying-programme. Miticides used were demeton-S-methyl, carbophenothion, ethion, methyl parathion or bidrin.

Rough bollworm (*Earias buegeli*) again did not build up to important numbers in Namoi River crops. For the third successive season it was scarcely of economic significance, but growers continued to incorporate endrin into spray schedules after about the end of January because the insect is very difficult to control once established in a crop.

Cotton aphid (*Aphis gossypii*) infested a few crops in March but specific control measures were unnecessary.

Insecticide and Miticide Field Screenings. Thirty-three insecticides and miticides, including standard materials, were evaluated in field screening-trials in February and March.

Of the newer materials, only lannate (Du Pont 1179) and bromophos at 1 lb a.i. per acre justify further consideration as possible alternatives to DDT or endosulfan for *Heliothis* control should resistance to the latter chemicals develop.

Naled at 4 oz., mevinphos, fenitrothion, Cyanamid 47031, Shell SD9129 and methyl parathion each at 8 oz, E.P.N. and lannate each at 1 lb, DDT plus toxaphene at 1 lb and 2 lb, and bromophos plus carbaryl at 1 lb and 1 lb a.i. per acre respectively, gave the best results against tobacco looper.

The most effective treatments against spider mite were naled and demeton-S-methyl at 4 oz, carbophenothion, ethion, methyl parathion, thiometon, dioxathion and Shell SD9129 each at 8 oz, and bromophos, E.P.N. and Schering 36103 each at 1 lb a.i. per acre.

The Cotton Pests Collection. Improvements and additions were made to the collection of cotton insects; 414 insects, taken at light-traps around cotton crops at Narrabri, were incorporated.

In interesting record was a noctuid moth (*Catablemma tri-gonographa*). The predatory larva of this moth feeds on aphids and scale insects.

Sunflower Insects

Rutherglen Bugs (*Nysius vinitor*). These built up in large numbers on grasses and weeds after rain in October and, with haying-off of much of this vegetation by mid-summer, invaded sunflower crops in the northwest. The adults pierced and sucked the main stems from about 3 in to 9 in below the heads. They clustered especially on weak or backward plants. Feeding caused a further general weakening and sometimes a malformation of the flowers. Colonies of nymphs were found later amongst the developing seeds, some of which were pierced.

In crops at Wallabahdah, Carroona, Spring Ridge, Curlew, Rocky Glen and Maules Creek, infestations were light where good weed-control had been maintained. Crops growing vigorously under irrigation at Narrabri, Carroona and Spring Ridge were only mildly affected, but those already under stress from lack of rainfall were severely affected.

Variable control was achieved with ultra-low volume malathion sprays, DDT, formothion and fenitrothion applied by aircraft. Good kills were obtained but adults soon re-infested sprayed crops. It is not yet clear whether Rutherglen bugs will be an annual problem.

Heliothis Caterpillars. These infested the flowers of an experimental crop at Narrabri. They fed in the fleshy tissue behind the flowers or on the florets. No significant seed damage occurred.

Tobacco Loopers (*Plusia argentifera*). The loopers caused minor foliage damage in the early stages of growth at Narrabri.

Safflower Insects

No pest of significance was observed in an experimental safflower crop growing under irrigation at Narrabri in September, October and November. Late in November, small numbers of flea beetles (*Longitarsus victoriensis*) were found feeding on the upper and undersides of the leaves, chewing into mesophyll areas and giving the plants a slightly speckled appearance. Damage was insignificant. Northern budworm (*Heliothis punctigera*) moths were seen nectar-feeding in November, but no egg-laying occurred. Shortly before the crop was harvested, small colonies of Rutherglen bugs (*Nysius vinitor*) were found on odd seed heads.

Soybean Insects

The pod-sucking bugs *Melanacanthus scutellaris*, *Dictyotus coenosus*, and green vegetable bug (*Nezara viridula*) were noted in small numbers in experimental sowings at Narrabri from December to February. A stem-boring longicorn (*Corrhenes picta*) attacked some plants growing under irrigation, but in most cases the plants were not weakened by the attack. Tobacco loopers (*Plusia argentifera*) damaged the foliage, and some differences in susceptibility to attack were apparent between varieties. A single caterpillar of the lucerne seed web moth (*Etiella behrii*) was found chewing into developing seeds. Northern budworm (*Heliothis punctigera*) severely infested a commercial irrigated crop at Narrabri.

Bloodworms in Rice Areas

Bloodworms (*Chironomidae*) seriously damaged aerially-sown rice in the Murrumbidgee and Murray River areas in spring. Pregerminated seed sown in infested water was damaged before roots became well developed.

In a laboratory pot-trial, fenthion at 0.1 p.p.m. gave excellent control of bloodworms in the presence of a decaying sward of pasture in water.

FRUIT TREE PESTS

Spider Mites

Studies of Tetranychus Urticae. Studies continued in the Murrumbidgee Irrigation Area on the behaviour and activity of two-spotted mite on peach trees.

Winter-forms were present until the last days of September in hibernation-positions in crotches, leaf litter, fruit mummies and under lifted bark on trees. Death rate of winter-forms rose sharply in early September and could not be correlated with disease or predation.

During the first two weeks of September there was heavy egg-laying on plants growing around the bases of trees, but none was observed on trees. Populations on the trees increased in October but dropped sharply at the end of November. Heavy rain and cooler temperatures, and lacewing predation, were important factors. Mite numbers did not build up again for several weeks, but there were big populations throughout January and February.

Baiting with protein hydrolysate continued, to stimulate populations of predatory lacewings.

In a miticide-screening trial at Yanco in February on a high population of two-spotted mite, the most effective materials after 14 days were I.C.I. omite 0.032 per cent, Schering T59 0.06 per cent, Murphy Chemical Co. MC1945 0.05 per cent, Philips duphar PH 76-15 0.15 per cent, CIBA 8514 0.1 per cent, dicofol 0.0375 per cent and Schering RS143 0.07 per cent. Delnav 0.02 per cent was very poor. After seven weeks the single applications of CIBA 8514 I.C.I. omite and Schering T59 were still effective.

At Orange, observations were made on the overwintering of two-spotted mite in garden habitats and in sheltered orchard habitats. In each situation there were orange-red winter-form and the normal two-spotted green female mites on a fairly wide range of host plants. In one garden, small numbers of eggs and nymphal stages were also observed. In sheltered habitats, where there was suitable herbage, limited breeding and feeding continued throughout the winter. Where the habitat was less sheltered and less suitable herbage was available (as in most orchards), activity was reduced and extremely little feeding and breeding took place. The only natural enemies observed were occasional adults of *Stethorus vagans* and *Scolothrips* sp.

Eggs and all active stages of two-spotted mite (*Tetranychus urticae*) were observed in August at Orange on weeds in an isolated orchard where snow was on bare ground near the weeds. The mites were also active in flower gardens.

Following an earlier observation that an overwintering form of *T. urticae* held in cold storage at 40°F produced viable eggs for twelve months, the longevity and fecundity of the form is being assessed. Overwintering forms were collected at Orange in August, 1966, and stored at Rydalmere at 40°F. Each week throughout the year 25 mites were deposited singly on to dwarf-bean leaf discs and held at room temperature in the laboratory. The longevity of the mites, the pre-ovipositional period, daily egg production, and incubation and developmental periods of the progeny as well as the ratio of males to females of the progeny of each mite were recorded.

A survey of the distribution and host records of spider mites was continued.

Banana Spider Mite (Tetranychus lambi). This severely damaged foliage in summer and autumn in newly established non-bearing plantations on the north coast. Predatory coccinellids (*Stethorus* sp.) reduced many infestations but supplementary control with dicofol or tetradifon was often required. Skin blemish from mite-feeding on banana fruit was not as severe as usual, but minor damage occurred in the Coffs Harbour and Murwillumbah districts.

Damage occurred almost exclusively on fruit covered with plastic tubing, the environment under the plastic covers apparently favouring mite development. Mite damage to fruit has increased in recent years, with extension of the practice of using plastic bunch-covers not only on winter-produced fruit but on bunches produced during much of the year.

Investigation of mite control on bunches continued. Dusting bunches with dicofol or tetradifon prevents fruit damage and is being compared with dichlorvos slow-release plastic-squares attached to bunches.

Pest Management in Pome Fruit Orchards

The Co-operative Project for Integrated Pest-control. A co-operative project of pest management in pome fruit orchards was initiated in 1966 between the CSIRO and the Departments of Agriculture in Victoria, South Australia, Tasmania and New South Wales. The project is financed from funds provided by the Australian Apple and Pear Board and the Commonwealth Government.

Six study-blocks* have been set up in pome fruit orchards; at Canberra, Hastings (Victoria), Grove (Tasmania), Blackwood (South Australia), and Leeton and Bathurst (N.S.W.); to study an integrated pest-control programme based on a uniform procedure of spray application of ryania.

The Bathurst Study-block. At Bathurst, codling moth infestation was very light because of unfavourable seasonal conditions. Infestation averaged between 1 and 2 per cent on sprayed trees and was only slightly higher on unsprayed trees. Extremely heavy damage was caused by apple dimpling bug (*Campylomma livida*) and it is evident that in some seasons insecticide intervention will be essential against this pest.

The ryania programme gave appreciable control of light-brown apple moth (*Epiphyas postvittana*) but infestation was considerably higher than with current commercial insecticides. The Jonathan variety was much more susceptible than Granny Smith to fruit damage by this pest. A number of natural enemies of light-brown apple moth were identified.

Two-spotted mite (*Tetranychus urticae*) was controlled by predatory insects and mites.

Two scales (*Parlatoria pittospori*) and San Jose scale (*Quadraspidiotus perniciosus*) appeared and although fruit infestation was light both may become more troublesome in the future.

The Leeton Study-block. At Leeton, where removal of cocooning shelter was carried out in addition to the ryania spraying programme, 27 per cent damage by codling moth was recorded. Two-spotted mite (*T. urticae*) seriously damaged foliage but was ultimately controlled by predators. Light-brown apple moth, *E. postvittana*, was abundant in ground cover but did not cause significant foliage or fruit damage. San Jose scale (*Q. perniciosus*) was present as a minor pest and no other insects were recorded in pest proportions.

Queensland Fruit Fly

Heavy and Widespread Incidence. Under relatively favourable rainfall conditions, fruit fly (*Strumeta tryoni*) activity was more pronounced than in the previous year. Fruit infestations were heavy on the north coast and northern tablelands.

Over-wintering was evident by substantial catches in male lure traps at Waterfall and by heavy stinging of green passion-fruit at Lismore in July. Heavy fruit-infestations occurred in coastal areas in September and October and extended to Inverell and Nowra in November.

Summer infestations, more serious than for some years, developed in coastal areas, on the northern tablelands, and at Nyngan in the central west. In February and March infestations extended into the north and southwestern slopes areas. Plague-like infestations occurred in the Metropolitan Area, on the north coast and the northern tablelands.

In the Murrumbidgee Irrigation Area and adjoining towns a fruit fly suppression scheme operates, with regular applications of malathion and protein hydrolysate and grids of male killer-lures. One adult was trapped in February, two in April and two in May at Griffith; one in March at Leeton and three in May at Coolamon. No larval infestation of fruit was recorded. No fruit fly was detected at Hay, Hillston or Narrandera.

Minor fruit-infestations were recorded at Cootamundra. Some stinging of quinces occurred in coastal and north-western areas, and of Washington Navel and maincrop Valencia oranges in coastal areas.

Survey of Fruit Flies. A survey of fruit flies occurring in north coastal areas was continued. Male-lure traps set out in the Richmond, Brunswick and Tweed River districts yielded mainly *Strumeta tryoni*, *S. humeralis* and *S. melas*. Small numbers of *S. bryoniae*, *Dacus absonifacies*, *Callantra aequalis* and *Austrodacus cucumis* were trapped. Ammonia-lures consistently yielded *S. tryoni*, *S. cacuminata* and *Dirioxa pornia*. Small numbers of *S. humeralis*, *S. halfordiae*, *S. bancroftii*, *S. stringatus*, *A. cucumis*, *C. aequalis*, *Afrodacus brunneus*, and a species nr. *D. pornia* were trapped.

A. brunneus was taken in traps at Stott's Creek, Tweed River, in September and twice in December; and at Breakfast Creek, Tweed River, in December. These constitute first records of the species in N.S.W.

S. strigatus was trapped four times in the Tweed River district and has only previously been recorded in N.S.W. in the Gosford area.

Queensland Fruit Fly larvae were found infesting the ripening fruit of ornamental almond (*Prunus pollardi*) in February in street plantings at Scone.

Attempts to obtain specimens of Trypetid larvae in melon fruits from the south west were continued but none was found during the year.

Male *Strumeta cacuminata* were observed clustering on clove-scented geranium in March at Oxford Falls, and females subsequently heavily infested the fruits of *Solanum verbascifolium* there.

Thirty-six samples of boxthorn (*Lycium lorridum*) berries were received, from Tamworth (24), Gunnedah (1), Bathurst (1), West Wyalong (1), Caringbah (2), Sans Souci (1) and Deniliquin (6). One sample of small-leaved lilli-pilli (*Syzygium luehmanni*) berries was received from Cammeray and two samples of palm fruits (*Butia capitata*) were collected at Rydalmere. Large numbers of Queensland Fruit Fly emerged from the small-leaved lilli-pilli berries and from the palm fruits.

The Citrus Commodity Treatment. This project, initiated in 1950 and financed by the citrus industry and the Commonwealth, South Australian, Victorian and New South Wales Departments, ended in 1966. The Citrus Wastage Research Laboratory at Gosford played a major part in the project.

EDB fumigation schedules were developed for oranges, winter-crop lemons, and mandarins (excluding var. Ellen-dale) to enable exports from fruit fly-affected areas. The treatments have been accepted by the New Zealand Government. Fumigation conditions and dose-rate schedules have been defined comprehensively and are available to supervisory export officers.

Larval Mortality Experiments with Marsh Grapefruit. In experiments during the year at Gosford, artificially infested Marsh grapefruit were fumigated with ethylene dibromide for 2 hours at 70°F; 20,246 larvae were killed by a 14 oz 1,000 cu ft dose rate and 21,546 larvae by an 18 oz dose, with no survivor in either case. No rind injury occurred, but in a previous season rind injury was so marked that EDB will not at present be considered for disinfestation of Marsh grapefruit.

Banana Disinfestation Studies. At Gosford, techniques for infesting bananas artificially with fruit fly larvae were improved, to provide material for disinfestation studies. Trials are being done with bananas to develop a dosage rate mortality

probit line graph for 2 hour fumigation with EDB at 70°F fruit temperature. This is expected to indicate the dose rate necessary for commercial fumigation. EDB has been tested at dose rates up to 10 oz 1,000 cu ft. Preliminary trials at very low rates have pointed to 6, 8 and 10 oz doses for intensive study. Some survival of larvae has occurred in fruit at rates up to 10 oz.

Study of Banana Uptake and Retention of EDB. A trial examining uptake and retention of EDB after fumigation of bananas at various stages of ripeness showed no notable differences in amount or longevity of EDB residues as between green, half-coloured and fully-coloured bananas (70°F, 2 hours, 8 oz EDB 1,000 cu ft fumigation). Almost all EDB residues were lost 24 hours after fumigation.

Oriental Fruit Moth

Incidence. Incidence of oriental fruit moth (*Cydia molesta*) was high this year in the Murrumbidgee Irrigation Area. Peak-catches of moths in lure traps were in the third week of November, the late December-early January period, and the third week of March.

Insecticide Screening Trial. Ryania was assessed in February in an insecticide screening trial, at 5 lb per 100 gal water, in replicated single-tree plots. The insecticide did not reduce tip damage, but the trial was marred by rainfall which shortly after application affected the insecticide deposit.

In another screening trial ryania, Du Pont 1179 and carbaryl were compared. The insecticides were assessed by counts of damaged tips, one and three weeks after spraying. None of the insecticides was effective.

Dried Fruit Beetles

Activity Levels Study. Syrup-lure pots were maintained in Murrumbidgee Irrigation Area peach orchards to ascertain the activity levels of dried fruit beetle (*Carpophilus* spp.). As in 1965, the highest numbers were trapped in late October and November. The numbers were low throughout summer and did not rise substantially until the end of April; after the peach harvest.

Apple Root Weevil

Study of Dieback Relationship. An experiment initiated at Batlow in August, 1963, to show whether injury by apple root weevil larvae (*Perperus* sp.) causes dieback in apple trees was continued. A minor growth difference was evident in September in favour of trees in soil from which weevils were eliminated with dieldrin, and trees in an adjacent infested area.

The growth-rates of trees on land from which old apple trees were grubbed immediately before replanting, and trees on land which had been under pasture for eight years after having previously grown apples, are also being compared. Trees were markedly less vigorous on land from which old trees had been grubbed immediately before replanting.

Survey of Insects and Mites of Citrus and Pome Fruits

This survey was initiated in November, 1966. Surveys were made in the Murrumbidgee Irrigation Area, in the Bathurst-Orange district, at Gosford, and in the Sydney metropolitan area. They will ultimately be extended to cover all major citrus and pome fruit areas of the State.

In the Murrumbidgee Irrigation Area 344 citrus insects representing 121 species, and 412 pome fruit insects (140 species), were collected; and at Bathurst-Orange, 592 pome insects (158 species), at Gosford, 210 citrus insects (82 species); in the metropolitan area, 293 citrus and pome insects (80 species).

An undescribed species of wax scale was recorded at West Pennant Hills on mandarin, and of a mealybug (*Rastrococcus* sp.) at Oxford Falls on lemon. A single specimen of bronze orange bug (*Musgraveia sulciventris*) a serious coastal pest of citrus, was found at Dubbo. A parlatoria scale (*Parlatoria pittospori*) was recorded for the first time on apple at Bathurst, and frosted scale (*Eulecanium prunosum*) on crabapple in a Bathurst-Orange locality.

Citrus Gall Wasp

Less Incidence. Incidence of citrus gall wasp (*Bruchophagus fellsii*) on backyard trees in the Sydney district was lower than for several years. This is considered the result of an intense gall-eradication campaign by Departmental fruit inspectors, and the activity of gall wasp parasites (*Epimegastigmus brevivulvus*) which are well established in the area.

Citrus gall wasp was found at a low level of infestation in the native shrub *Eremocitrus glauca* (desert lime) at Pallamallawa in the north west in September. The parasite *Epimega-stigmus brevipalvus* was also present. Another trace infestation in the northwest was in a home garden orange tree at Melee in April.

Galls were collected from the native finger lime (*Microcitrus australasica*) in the Tweed Valley in September. Common lemon trees in the area were usually heavily galled, but commercial varieties of citrus were only lightly infested.

Experiments for Control. Experiments on Eureka lemon trees were continued at Oxford Falls. The long-term trial to determine the effectiveness of spring application of fungicides and insecticides in preventing gall wasp attack on rejuvenating trees has not yet yielded results. Re-infestation of the trees has been very slow. However, common lemon suckers under and around the trees have been rapidly and severely re-infested.

Single spray applications of dimethoate e.c. 0.1 per cent, mevinphos e.c. 0.1 per cent, demeton-S-methyl 0.1 per cent, endosulfan e.c. 0.1 per cent, and methidathion e.c. 0.1 per cent on infested common lemon seedlings in mid-August caused no mortality of gall wasp larvae.

Trunk injection with bidrin into infested Eureka lemon trees in April, or in mid-August, caused no mortality of gall wasp, nor did soil application under infested Eureka trees in April with phorate at $\frac{1}{2}$, 1 or 2 oz a.i. per tree or Union Carbide UC 21149 at 4, 8 or 16 oz a.i. per tree.

Citrus Red Scale

Incidence. Fruit infestations by red scale (*Aonidiella aurantii*) were commonly on winter-crop lemons, and tree-infestations in spring and early summer caused leaf fall and twig dieback on young neglected trees and trees covered with road dust, in the Gosford district. Heavy infestations developed in summer and autumn on unsprayed trees in the Murrumbidgee Irrigation Area.

Spray Trials in the M.I.A. Final assessments in the 1965-66 red scale spraying-trial on Valencia oranges in the Murrumbidgee Irrigation Area, of single treatments applied at the end of February, showed good control from standard recommendations. These were dimethoate w.p. 0.025 per cent plus white oil 1/100, ethion 6 per cent-in-oil at 1/100, azinphos methyl w.p. 0.05 per cent plus white oil 1/100, malathion high concentrate liquid at 0.15 per cent plus white oil 1/100 and 0.1 per cent plus white oil 1/100, formothion e.c. 0.05 per cent plus white oil 1/100 and 0.025 per cent plus white oil 1/100 and ethoate-methyl w.p. 0.025 per cent plus white oil 1/100; whilst fenitrothion w.p. at 0.06 per cent plus white oil 1/100 was less effective. None of the materials caused fruit blemish.

Preliminary assessments of the 1966-67 spraying trial on Valencia oranges, in the Murrumbidgee Irrigation Area, of single treatments applied in the first week of March, showed good results with dimethoate w.p. 0.03 per cent plus white oil 1/100, malathion high concentrate liquid at 0.15 per cent plus white oil 1/100 and 0.1 per cent plus white oil 1/100, phenthoate w.p. 0.05 per cent plus white oil 1/100 and the new organophosphorus compound Bayer 5089 e.c. 0.05 per cent plus white oil 1/100. All appeared better than malathion w.p. 0.1 per cent plus white oil 1/100. No fruit blemish was seen, from any treatment.

White Wax Scale

Incidence. The usual heavy infestations by white wax scale (*Ceroplastes destructor*), accompanied by honey-dew production and sooty-mould, occurred in unsprayed orchards.

Spray Trial. Carbaryl at 0.05 per cent plus white oil 1/100 is highly effective against white wax scale but stimulates purple scale (*Lepidosaphes beckii*). The latter is of considerable importance in some coastal areas. Carbamult is effective against white wax scale but is untested against purple scale.

A spray trial was initiated at Narara Horticultural Research Station, to compare carbamult and carbaryl as stimulating agents on purple scale. Results are not yet available.

Citrus Red Mite

First Record in Australia. Citrus red mite (*Panonychus citri*), a very important pest of citrus in California and also known as purple mite in some North American citrus areas, was recorded for the first time in Australia. This was at Oxford Falls, metropolitan area, in spring, 1966. The mites were on lemon trees, in very small numbers. No tree injury was evident and the infestation did not develop further.

Silver Mite, of Citrus

Incidence and Control. This pest (*Hemitarsonemus latus*) caused little commercial damage on lemon fruit, the usual host. A heavy infestation developed on potted citrus seedlings in a shadehouse at Narara in March. In the humid conditions, favourable to mite development, a single application of chlorpropylate e.c. 0.03 per cent did not control it. A second spray, using chlorpropylate e.c. 0.03 per cent plus white oil $\frac{1}{2}$ /100, coinciding with a change to drier weather, gave complete control.

Citrus Stem-End Scurfing Blemish (Thrips?)

Incidence. A flat scurfing-blemish around the stem-end of oranges and grapefruit, troublesome in lower Murray orchards in recent years, is suspected as caused by thrips feeding under the sepals of very young fruit. Thrips collected under sepals in November, 1965, were identified this year, but there was no species of known major importance present.

Spray Trial. In November a preliminary trial at Dareton, with azinphos w.p. 0.05 per cent plus white oil 1/100 applied in November, 1965, to grapefruit trees bearing young fruit, was assessed. Two per cent of sprayed mature-fruits were blemished, compared with 61 per cent of unsprayed fruits. Further trials are proceeding with single applications of azinphos w.p. 0.05 per cent plus white oil $\frac{1}{2}$ /100, carbaryl w.p. 0.05 per cent plus white oil $\frac{1}{2}$ /100 and dieldrin e.c. 0.05 per cent, on oranges at Monak in the lower Murray.

Banana Beetle Borer

The Eradication Campaign. The banana industry has been attempting eradication of beetle borer (*Cosmopolites sordidus*) at Coffs Harbour since the pest was discovered there in 1961 in five plantations covering an area of 64 acres.

Inspection of the areas in 1967, after intensive annual-treatments with dieldrin, suggested that all infested plantations were free of beetle borer. But in December, 1966, and the months following, new infestations were found on nine plantations with an area of over 100 acres. Most of the infestations were located at Red Hill, an area of several hundreds of acres of contiguous plantations. The recent discoveries of beetle borer complicate the eradication programme.

Pineapple Decline

Incidence. This was again the major disease of pineapples in the State. It appears in plants before the first fruit and causes a yellowing of leaves, unthriftiness, low yield and premature crop-failure.

Experiments for Control. An experiment initiated in 1963, to assess the roles of pasture white grub (*Rhopaea magnicornis*) and nematodes, has been concluded. Treatments were (a) EDB pre-plant fumigation plus DBCP annual post-plant fumigation; (b) DDT plus parathion pre-plant soil treatment; (c) combined (a) and (b); (d) untreated control.

Pre-plant fumigation of soil with ethylene dibromide, followed by annual post-planting fumigations with DBCP, prevented major nematode-infestation of roots and was reflected in enhanced leaf-growth, vigorous ratooning and high yield compared with plants in unfumigated plots. Damage by the pasture white grub was evident on the rhizomes of plants of all plots, regardless of treatment, and was severe on most of the plants. Pre-plant DDT/parathion soil treatment was ineffective on a long term basis.

Another experiment has been started, in a new sowing of pineapples at Alstonville, aimed at control of pasture white grub. The whole experimental area was fumigated with ethylene dibromide and will receive annual fumigations with DBCP. Insecticides under test include dieldrin applied as granules, and by injection, DDT and parathion.

Macadamia Leaf Miner

Incidence. Macadamia leaf miners (*Acrocercops chionosema*) heavily infested young foliage of *Macadamia integrifolia* and *M. tetraphylla* in a number of localities in the Tweed River district. Egg-laying continued from July to May with each flush of new foliage, and mining and blistering of leaves were very damaging on young trees.

Study of the Insect Biology. Further aspects of the biology of the insect were studied. The pattern of larval development was clarified, using field-collected material, the larvae passing through a total of four instars.

A number of larval parasites were also found.

STORED PRODUCT PESTS

Wheat Pests

Dust-protectant Trials. The trial of dust protectants commenced at Condobolin in May, 1965, with treatments replicated in 44-gallon drums, was continued. After two years, two of the bromophos 6 p.p.m. treatments were heavily infested with lesser grain borer (*Rhyzopertha dominica*). The pest was present in control drums a year earlier. Confused flour beetle (*Tribolium confusum*) was the most numerous insect in the control drums after two years. It also infested wheat dusted with carbaryl 10 p.p.m. and synergised pyrethrin 1.7 p.p.m. The malathion 10 p.p.m., fenitrothion 2.5 p.p.m. and 5 p.p.m., and diazinon 4 p.p.m. treatments were still free of infestation.

A trial to compare finely-ground magnesite and malathion dusts as protectants for wheat stored in farm silos was commenced at Condobolin in December, 1966. The magnesite, mined at Thuddungra, was added to wheat during filling of two 2,000 bushel galvanized-iron silos at the rate of 1 per cent by weight. Malathion 10 p.p.m. was applied to wheat as a 2 per cent talc-based dust as it was augered into another silo. A fourth silo was filled with untreated grain as a control. By May the control silo was infested throughout with saw-toothed grain beetle (*Oryzaephilus surinamensis*) and *R. dominica*. A few of both pests occurred in the magnesite-treated wheat but the malathion treatment was free of infestation.

Spray-protectant Trials. A trial of protectants sprayed on to the wheat grain at intake to Billimari silo in December, 1964, was concluded in July, 1966. The control bin was at that time heavily infested with saw-toothed grain beetle (*Oryzaephilus surinamensis*) and lesser grain borer (*Rhyzopertha dominica*) while the bins treated with fenitrothion 2.5 p.p.m. and 5 p.p.m. malathion 12 p.p.m. were still uninfested 19 months after treatment. Minor breeding of *R. dominica* was observed in laboratory bio-assay of samples of fenitrothion-treated wheat taken from this trial in February and April, 1966.

A further trial of grain protectants commenced at Grenfell and Garema silos in December, 1965, was concluded in September, 1966. In July, bromophos 12 p.p.m. treatments at both silos were so heavily infested with *R. dominica* that fumigation was necessary. The fenitrothion 6 p.p.m. and malathion 12 p.p.m. treatments were free of insect infestation, as also was a control bin at Grenfell suspected earlier of being contaminated with insecticide.

Another trial to evaluate a synthetic pyrethrin as a wheat protectant was commenced in December, 1965, at Greenthorpe and Wattamondara silos, and concluded in July, 1966. At the final sampling, flour beetles *Tribolium* spp. and *O. surinamensis* were found infesting synthetic-pyrethrin 3 p.p.m. treatments at both silos while malathion 12 p.p.m. and control bins were uninfested.

Field-infestation Survey. A survey of wheat-ear samples was conducted this year. Ninety-four samples, each comprising about 50 ears taken from a crop just before harvest, were received from all parts of the wheat belt. None of the samples contained any of the normal stored-grain pests, either at the initial examination or after an incubation period to allow immature insects to emerge.

Polyethylene-packaging of Wheat. Packages of wheat sealed in 0.006, 0.004, and 0.0015 in polyethylene film and subjected to insect infestation for two years were examined finally in August, 1966. Packages, of each thickness, had been placed at random in drums and subjected to a mixed population of rice weevil (*Sitophilus oryzae*), lesser grain borer (*Rhyzopertha dominica*), rust-red flour beetle (*Tribolium castaneum*), saw-toothed grain beetle (*Oryzaephilus surinamensis*) and tobacco beetle (*Lasioderma serricornis*). The insect population was introduced into each drum with a small quantity of food material.

All thicknesses of film were penetrated in long-term storage. Severity of attack depended on position of packages in the drums. The 0.006 and 0.004 in packages on top of other packages suffered little or no penetration, but were severely damaged when placed on the bottoms of drums beneath other packages.

The 0.0015 in. film was severely penetrated regardless of position in the drum, and penetration was evident by only two weeks after the trial started.

At six weeks, *O. surinamensis* was the only species found inside bags entered by gnawed holes, although *R. dominica* was observed gnawing at the polyethylene. *L. serricornis* did not persist in the drums, but eventually all the other insects entered the penetrated packets. The predatory bug *Xylocoris flavipes* also became established inside the infested packets.

Prey of the Predatory Bug (*Xylocoris flavipes*). An experiment to determine the prey of the stored-product predatory bug (*Xylocoris flavipes*) was commenced in August. Adults and nymphs of the predator were introduced into jars containing separate cultures of saw-toothed grain beetle (*Oryzaephilus surinamensis*), rust-red flour beetle (*Tribolium castaneum*), rice weevil (*Sitophilus oryzae*) and lesser grain borer (*Rhyzopertha dominica*).

Two months later the predator had multiplied and was flourishing in the *O. surinamensis* and *R. dominica* cultures. There was no trace of the bugs introduced into the *T. castaneum* culture. Results were indeterminate with *S. oryzae*, as the culture died.

Maize pests in Storage

Field-infestation Survey. The examination of incubated maize samples, collected in a survey of field-infestation of maize cobs by stored-product pests in north and south coast districts during May, 1966, was completed in September.

Hundreds of adults of the Angoumois grain moth (*Sitotroga cerealella*) emerged from five of the six samples collected in the Moruya-Bega area.

The maize weevil (*Sitophilus zeamais*) emerged from nine and *S. cerealella* from five of the 22 samples collected on the north coast. Samples from three crops near Grafton and one near Casino were seriously infested. Samples from four crops near Lismore were free of infestation. Two samples collected near Tabulam contained light *S. cerealella* infestation and one from Plains Station, a major certified-seed producing area south of Tabulam, was not infested. A sample from an early-planted crop north of Kyogle, in which *S. cerealella* infestation was obvious in the field, yielded only one moth. Samples from two isolated crops on the upper Clarence at Winegrove and at Jackadgery were free of infestation.

Dust-protectants Trials. A trial of protectants for maize stored on the cob was started at Grafton in September, 1966. It followed an earlier trial in which malathion dust formulated on an offal sharps base was the most effective protectant, but at the high application rate of 2 lb of 1 per cent dust per 18 cubic feet of cobs (about 40 p.p.m.). In the present trial malathion 1 per cent dust formulated on a talc base is under comparison with the offal sharps formulation and with finely-ground magnesite and the sorptive-dust drione.

In February, severe *S. cerealella* infestation had developed in untreated-control cobs and in magnesite-treatments 0.5 per cent and 1 per cent by weight and the drione-treatment 0.1 per cent by weight. Malathion treatments 0.25 per cent by weight were moderately infested but few moths were present in the 0.5 per cent by weight malathion dust (about 40 p.p.m. malathion) treatments. There was no apparent difference between the talc- and offal sharps-based formulations of malathion dust.

Temperatures measured with the Radson probe were 6–11°F higher in the heavily infested treatments than in the two cribs treated with the higher rate of malathion dust.

By April, moth infestation had declined but maize weevil (*Sitophilus zeamais*), rice weevil (*S. oryzae*), and rust-red flour beetle (*Tribolium castaneum*) were numerous in untreated cobs and those dusted with drione and the lower rate of magnesite. The malathion-treated cobs and those dusted with the higher rate of magnesite were only lightly infested.

A trial of five candidate insecticide-dust protectants for maize grain was also commenced at Grafton in September, 1966. The insecticides and grain were mixed in a concrete-mixer. At the February-sampling Indian meal moth (*Plodia interpunctella*) and *S. cerealella* adults, weevils and parasitic wasps were obvious on the untreated grain containers. *P. interpunctella* adults and larvae were seen on the surface of the magnesite-treatment 1 per cent by weight where the grain had been webbed into lumps by the larvae. Malathion 12 p.p.m., fenitrothion 5 p.p.m., lindane 5 p.p.m. and drione 0.1 per cent by weight treatments were free of infestation. The temperature in the control containers was 15°F higher than in the treated grain at this time. Both talc and offal sharps formulations of malathion 1 per cent dust were included in the trial.

At the April sampling, *S. cerealella* was the only moth seen on the surface of the grain. Only the evidence of *P. interpunctella* activity remained in the magnesite treatments. *S. zeamais*, *S. oryzae* and *T. castaneum* were numerous in the control containers. *S. oryzae* was most active in the fenitrothion-treated grain and also infested the magnesite, lindane and malathion (talc formulation) treatments. The drione-treated grain was virtually free of insect infestation while the malathion (offal sharps formulation) contained numerous dead *S. oryzae*.

An investigation of the effect of incorporating insecticide protectants with hammermilled maize was commenced at Grafton in September, 1966. Magnesite 0.5 per cent and 1 per cent by weight, drione 0.1 per cent by weight and malathion 12 p.p.m. (as a 1 per cent dust) were mixed with the hammermilled maize in a concrete-mixer and each treatment was stored in 2-bushel boxes.

In April all the hammermilled maize carried insect infestation regardless of treatment, including *S. zeamais*, *S. oryzae*, *T. castaneum*, flat grain beetle (*Cryptolestes* sp.) and sawtoothed grain beetle (*Oryzaephilus surinamensis*). At the April sampling and the previous sampling in February, moths including *P. interpunctella*, *S. cerealella*, tropical warehouse moth (*Cadra cautella*) and meal snout moth (*Pyralis farinalis*) were found resting beneath the lids of the boxes when they were opened. Apart from one replicate in which *Cryptolestes* sp. was numerous, the control material was no more infested than most of the treated material.

Study of Stored Hammermilled Maize Susceptibilities. Susceptibility of stored hammermilled maize to insect attack was further investigated. About 500 bushels of maize on the cob were hammermilled and placed in a bulk-storage bin at Grafton in December, 1966. The bin was formed by lining the ventilated side-wall of a maize barn with bitumen-laminated kraft paper, and building unlined 6 ft timberwalls inside the barn. The wooden floor of the barn was approximately 1 ft off the ground.

In February, insect activity was obvious on the surface of the hammermilled maize but not so evident at depth in the material. *P. interpunctella*, *C. cautella*, *S. cerealella* moths and *Tribolium castaneum*, *S. zeamais*, *S. oryzae* and black ants were seen on the surface.

Temperatures of 86–96°F were recorded on the surface and at 6 in depth. Below this the material was cooler. *T. castaneum* was the main insect present deep in the material. It was more numerous there than on the surface.

About half the hammermilled maize was removed from the southern end of the bulk in April and used for feed. At this time *T. castaneum* and flat grain beetle (*Cryptolestes* sp.) were the most numerous insects and were active mainly on the surface and sides of the bulk, together with *S. zeamais*, *S. oryzae*, *O. surinamensis*, *R. dominica*, dried fruit beetle (*Carpophilus* sp.) and the cadelle (*Tenebroides mauritanicus*). The moth larvae and adults which were numerous in February were no longer evident.

There was much less insect activity at depth in the bulk than on the surface. The temperature at 6 in to 6 ft depth ranged from 86–99°F, while the highest surface temperature recorded was 82°F. There was slight moulding of the maize against the timber wall of the bin but the bulk of the material was in good condition.

Pests in Dried Figs from Turkey

Dried figs imported from Ismir, Turkey, in October, 1966, were found after distribution to retail stores to be infested with larvae of the dried fruit beetle (*Carpophilus hemipterus*) and dried fruit mite (*Carpoglyphus lactis*). The moisture content of four samples of the figs was about 23 per cent. This is accepted as normal for dried figs. It has generally been considered that *C. lactis* infestation develops only in overmoist dried-fruit.

Pest in Dried Broad Beans from Italy

Broad Bean Weevil (*Bruchus rufimanus*). An infestation was discovered in October, 1966, in a consignment of broad beans from Italy. These had been landed in Sydney 36 days earlier. Only one previous shipment infested by *B. rufimanus* had been intercepted in Sydney. Since July, 1962, there were 11 other shipments of broad beans wherein no infestation was found. It was evident that this pest could have evaded detection in quarantine because of its long life-cycle. The probability of it becoming established is lessened since the beans are cooked for eating.

One bag of the October consignment had been sold before it could be recalled, but the rest of the shipment was fumigated. An examination showed that the fumigation was effective; 89 beans, from five bags, contained 153 dead larvae and two dead adults of *B. rufimanus*.

As a check on the establishment of this pest, one sample of broad beans, grown at Ashfield and harvested in November, was incubated for seven months but showed no sign of infestation.

VEGETABLE PESTS

Potato Moth

Project with Parasite (*Apanteles subandinus*). A joint project with the Division of Entomology, CSIRO was initiated to find whether parasites of potato moth (*Phthorimaea operculella*) could be established in sufficient numbers in the Orange district to have a significant controlling-effect on moth populations.

Parasite liberations were delayed by prolonged cool, wet weather, adverse to the pest. However, samplings of potato moth larvae in the intended parasite-liberation areas indicated that the principal parasite to be used (*Apanteles subandinus*) was already well-established in the area. This was traced to a very small liberation made in an adjoining locality two years earlier.

It is evident that the parasite can establish efficiently in the area. Whether it can lower moth populations sufficiently to prevent significant yield- and tuber-loss remains to be shown.

Carrot Aphid Survey in the M.I.A.

A survey of the aphids occurring in carrot crops in the Murrumbidgee Irrigation Area in winter revealed the presence of *Hyadaphis foeniculi*, *Dysaphis foeniculus*, and *Myzus persicae*.

ANIMAL PESTS

Sheep Blowfly

Insecticide tolerance Studies. Tolerance of *Lucilia cuprina* to organophosphorus (O.P.) insecticides, first-discovered in late 1965, is now known to be in field populations throughout the major wool-growing areas of the State. Further use of O.P. chemicals over the past fly-season resulted in an increase in the order of tolerance to about 10 times above normal. Flies with an enhanced order of tolerance were diagnosed from properties throughout the north west.

Evidence of pre-existent tolerance to butacarb, a carbamate insecticide registered for prevention of flystrike in sheep, was investigated. A single instance of tolerance was determined in a field-strain from Goondiwindi in late 1966.

Semi-field studies involving attempts at the establishment of artificial strikes in sheep treated with O.P. and carbamate insecticides indicated that these chemicals provide useful protection against flystrike, despite the presence of field populations with an enhanced order of O.P. tolerance. Parallel studies with a butacarb-tolerant strain indicated that this insecticide has retained much of its effectiveness.

Properties from which complaints were received concerning the ineffectiveness of O.P. chemicals were inspected. Insufficient attention to jetting-technique appeared to be the major reason for early strikes after jetting with O.P. insecticides.

DOMESTIC PESTS

The Argentine Ants Campaign

Some 323 acres of *Iridomyrex humilis* infestation in 20 new areas of infestation were sprayed this year; with 21,305 gallons of 2 per cent chlordane and 11,627 gallons of 0.75 per cent dieldrin. At one stage in November, 1966, all known areas of infestation had been sprayed. In October, and for all future spraying, chlordane was substituted for dieldrin.

A publicity campaign during the summer, using mainly television but also newspapers and radio, led to receipt of 14,547 samples of ants. From these, 19 new areas of infestation were discovered. The 19 were widely scattered through the Sydney area and included areas at Pitt Town (near Windsor), Dural (near Hornsby), and other outer areas. The areas ranged in size from apparently one nest to 80 acres.

A total of 31 new infestations covering an area of about 700 acres was reported during the year. Five were reported by the public before the abovementioned campaign and two were found by campaign-personnel. One of the five was reported from Oak Flats (Shellharbour Municipality) and this is notable as the first report of the ants from outside the Sydney-Wollongong areas.

Since April, 1950, there have been 300 infestations reported, comprising an area of about 7,300 acres. Fifteen infestations now remain to be sprayed. These should be completed early in 1968.

Caddis Flies

Control in Water-lily Pond. Addition of dimethoate to water-lily pond-water at 2 fl. oz 30 per cent e.c. per 1,000 gallons at Gosford in December, controlled caddis fly (*Trichoptera*) larvae-damage to water-lily stems. This enabled successful establishment of commercial ponds, without harm to small fish. The rate, equivalent to 3,750 micrograms dimethoate per litre, is well below the known LC50 (a concentration killing 50 per cent of the population in 24 hour period) for rainbow trout, of 20,000 micrograms dimethoate per litre, and for bluegills, of 28,000 micrograms per litre.

Silverfish

Experiment for Improved Control. A trial was conducted in November, 1966, to investigate the attractiveness of a starch paste and a polyvinylacetate (PVA) adhesive to the silverfish (*Ctenolepisma longicaudata*) and to determine if the addition of 2 per cent methoxychlor to the pastes would control the insect.

The pastes were applied to the inner surfaces of bristol board rolled to form a cylinder.

The trial was concluded after 23 days. Most of the silverfish in all treatments survived. Those that died probably succumbed to injury sustained during handling or disturbance. It was evident that the silverfish had fed on both inner and outer surfaces of untreated cylinders and on the outer unpasted surfaces of the treated cylinders, but no feeding occurred on any of the pasted surfaces.

Cockroaches

Assessment of Treatments. Two rooms heavily infested with German cockroach (*Blattella germanica*) and to some extent with American cockroach (*Periplaneta americana*) were sprayed with 1 per cent aprocarb in December. Strong flushing and rapid knockdown of both species of cockroach were observed. Approximately a gallon of dead cockroaches was swept from the floor of the rooms on the morning following spraying.

B. germanica re-infested one room containing food and domestic heaters after six weeks but *P. americana* were still being killed by the insecticide residue nine weeks after treatment. The other room, which was a less favourable harbourage for cockroaches, remained free of infestation for four months. Then *B. germanica* re-infestation occurred.

The first room was re-sprayed with 1 per cent aprocarb in February, resulting in knockdown of about $\frac{1}{2}$ pint of cockroaches, mainly *B. germanica* with a few *P. americana*. A further $\frac{1}{4}$ pint was collected in the two days after treatment, suggesting re-infestation from surrounding buildings. The treatment remained effective for two months. Then some re-infestation by *B. germanica* occurred behind a water heater.

The sorptive-dust drone was assessed in February, 1967. Both *B. germanica* and *P. americana* were flushed from cavities when the dust was applied, and numerous dead *B. germanica* were observed two hours after treatment. The treated area remained relatively free of cockroaches despite heavy nearby-infestations and constant re-introduction of cockroaches in animal feed.

In April the dust was applied to four heated animal-pens and to the roof cavity above. On the day after treatment, numerous dead *B. germanica* were swept up but there were some survivors. Sixteen days after treatment the infestation was under control.

SYSTEMATIC STUDIES

Distribution and Taxonomy of Aphids

The aphid-trapping programmes were continued. Many thousands of specimens were examined and identified and several interesting occurrences and new records obtained.

The Insect Collection

This year 1,796 insects were incorporated into the collection, together with 33 specimens of spirit material. Some 2,689 insects were mounted and 610 remounted.

Three major groups and a number of minor batches of insects were sent to Australian and overseas specialists for identification.

The following genera of the F. Tenebrionidae were rearranged: *Onosterrhus*, *Nyctozeilus*, *Styrus*, *Byallius*, *Sloanea*, *Asphalus*, *Hydrius*, *Encyalosthus*, *Promethis*, *Menephilus*, *Teremenes*, *Meneristes*, *Tenebrio*, *Toxicum*, *Lesispilus*, *Oremasis*, *Paraphanes*, *Anaasis*, *Lygestira*, *Titaena*, *Cardiothorax*, *Otrinus*, *Blepegenes*, *Licinoma*, and part of *Adelium*.

Revision of Scientific and Common Names of Insects

A committee of CSIRO, South Australian, Tasmanian, Queensland, and New South Wales representatives, appointed in 1961 by the Conference of Commonwealth and State Entomologists to revise the publication "Common Names of Insects and Allied Forms occurring in Australia", completed its work this year—with publication of a new edition of the bulletin.

Study of the Curculionidae

Some 423 specimens were added to the collection of weevils. They are new mounts in the following subfamilies: Brachyderinae (53), Eremninae (23), Leptopinae (133), Gonipterinae (169), Cleoninae (25), Belinae (9).

Chemistry Branch

ADMINISTRATIVE CHANGES

Former Chief Chemist Mr T. H. Johns, M.Sc., is now Chief of the Division of Science Services in succession to Dr C. J. Magee, retired. Former Senior Chemist Mr A. N. Old, B.A., B.Sc.Agr., succeeded to Mr Johns as Chief Chemist, and Dr D. K. O'Neill, Ph.D., M.Sc., became Senior Chemist, as from 17th November, 1966; and Mr W. S. Gilbert B.Sc., succeeded to Dr O'Neill as senior officer of the Pesticides Section of Chemistry Branch.

CEREAL SECTION

The Wheat Crop

Record Production. From the record harvest, some 184,175,000 bushels had been delivered to storages in N.S.W. by the end of June, 1967, whilst about another six million bushels had been moved through Victoria. Allowing for late deliveries and also for wheat held on farms for seed and feed, the total crop obviously exceeded 200 million bushels. About 34 per cent of the wheat received was off-grade.

Some 16.7 million bushels drew a premium payment. This was a big increase in premium wheat and mainly due to bulk receipts of prime hard grade destined for export.

Five Grades Declared. Grades were declared as follow: Northern F.A.Q., Southwestern F.A.Q., Prime Hard, Northern Off-grade and Southwestern Off-grade. Analysis of the official samples confirmed the reasonably clean nature of the wheat, particularly from the southwestern areas. This would materially assist in marketing the record crop.

Protein Content High. Particularly in the northwest the protein content was high. About 15 million bushels graded as prime hard averaged 14.2 per cent protein, and the northern F.A.Q. averaged 12.5 per cent protein. Protein levels in the southwest, for both F.A.Q. and off-grade, were around 11.0 per cent which is quite reasonable.

It is a feature of the year that high protein figures have been associated with a big crop, whereas in past years high yields have always been associated with lower levels of protein.

Classifying Weather Damaged Wheat. Each year a portion of the N.S.W. wheat crop has to be downgraded as an effect of weather; due to lowering of bushel weight or bleaching or some initiation of germination (sprouting or shot and sprung).

Due to weather damage in Victoria at the previous harvest, the Australian Wheat Board asked the Chemistry Branch of this Department to examine the possibility of a practical measure of the amount of sprouting that may have occurred, and of establishing uniformity of nomenclature.

Once wheat commences germination processes the enzyme-systems which normally break down starches, to make simple food-forms available to the new growing plant, become active. This enzyme-activity is measured in assessing the degree of "sprout damage", but such methods are not designed for field use. The operator at a silo has a choice of two alternatives: "sound wheat" or "sprouted".

Standardization of Moisture Meters, and Moisture Testing

The results of measurements of grain moisture by wheat-handling authorities have at times been contentious, particularly at harvest time. The Cereal Laboratory often advises the grain-handling authorities on measurement-methods and instruments. In the latter half of 1966 it was found convenient to examine all moisture-meters belonging to the Grain Elevators Board. This involved the testing and standardization of 230 stem-type hygrometers and 20 electronic moisture-meters.

The Stem-type Meters. These were first purchased by the grain-handling authority in 1957. In light of the comprehensive testing done on the 230 meters this year, these instruments are considered still to serve a useful purpose if properly handled in the field.

The investigations confirmed that the meters should always be held in a bulk of wheat when not in actual use; and also that they respond more rapidly, and reach equilibrium sooner, when going from a lower to a higher moisture-content sample. Under the recommended conditions, an accuracy of plus or minus 0.5 per cent moisture could be expected in 90 per cent of the readings.

Electronic Moisture-meters, and Temperature Effects. The Cereal Section did a preliminary field-survey at the 1966 harvest, to observe the effect of grain-temperature on measurement of grain-moisture and determine the field-value of certain meters.

Successful operation of some electronic moisture-meters depends on the temperature of the measuring-cells, equilibrium in the grain under test, and corrections for variations in temperature from the standard figure at which the instrument is calibrated. Most instruments are of overseas design and the standard calibration point is usually in the 65–75°F range.

The pilot-survey showed that grain-temperatures under northern New South Wales conditions are more likely to be around 90°F, and that under very hot conditions surface grain-temperatures can rise to 120°F.

Sampling of large bulks of material is a constantly recurring problem in agriculture, and variation within wheat trucks delivering to a silo is no exception. Variations in temperature were found at different levels and different positions within loads, as was also the case with moisture content. Sampling-techniques had to be adopted such that sampling-errors were minimized.

Within one day's delivery at Narrabri, silo temperature-variations between wheat levels were found to be 30°F. This could cause a variation of over 2 per cent in the moisture-content reading if not properly compensated for by the operator.

Laboratory-output Statistics

Grain and Flour Samples. Two thousand and fifty-seven grain and flour samples were received, besides 271 moisture meters for testing. Of the 2,057 samples, 205 were flour samples mainly from export shipments.

Wheat samples comprised most of the receivals; and 490 have been milled so far from the 1966–67 crop whilst 678 test loaves have been produced in experimental-baking.

Other routine laboratory-output included 4,600 protein determinations and 2,400 moisture determinations.

Certification of Export Wheat and Flour

The Export Wheat. In the first six of the twelve months under report, exports were almost at a standstill. Exports out of Newcastle did not really start till December, 1966. For the year, fifty-six shipments were certified; thirty-three from Sydney and twenty-three from Newcastle.

A running-check is maintained on all shipments from both ports. Representative samples are taken by staff of the Department's Export and Import Branch, from each shift during the loading of a vessel, and these are forwarded to the Chemistry Branch. A weighted composite-sample, prepared for every shipment, is then subjected to laboratory analysis.

China and Brazil are the two main markets requiring certificates beyond the normal phyto-sanitary certificate issued by the Export and Import Branch. Some certificates were also provided for shipments to South Africa, Mozambique and Pakistan.

The certificates, covering the fifty-six shipments, were for 934,000 tons (35.3 million bushels). The total comprised 297,000 tons F.A.Q. and 337,000 tons off-grade from Sydney; and 24,000 tons prime, 276,000 tons F.A.Q. and 12,000 tons off-grade from Newcastle.

The exported wheat of the 1966–67 crop has had good appearance and high bushel weight, and the amount of admixture (foreign seeds, straw, chaff, etc.) has been small—in some shipments as low as 0.15 per cent. These factors augur well for continued export-demand.

Although there were large shipments of off-grade wheat, particularly to China, this wheat was also of good quality. Its bushel-weight, admixture, protein and moisture content were similar to the season's F.A.Q. The widespread rainfall at harvest had some bleaching and some sprouting effect sufficient for the wheat to be slightly downgraded to the off-grade standard.

The Export Flour. Australian exports of flour for the first ten months of the financial year were lower again than for the corresponding period of the previous year. In terms of overseas market for flour and flour products this is significant since in the previous year there had been a ban on flour exports so far as New South Wales was concerned, because of the drought-effect on crop volume.

Fifteen certificates were issued this year, concerned with 64,000 tons of flour. Several of the larger export-shipments were to the traditional flour-market in Ceylon. It is noted that a further flour-mill now under construction in Colombo is expected to be into production by late 1967, and will produce about 50,000 tons annually.

In the certified flour-exports was a shipment of 10,000 tons of Atta flour to India, a gift from the Australian Government. Atta flour is a coarse meal made from wheat. It includes 85–95 per cent of the total wheat-grain, with the large bran-particles removed. It is traditionally used in India to make chippaties.

The Cereal Section assisted the New South Wales flour millers to a satisfactory specification for production of the Atta flour. There had been no known export of it from New South Wales since 1947, but there are regular shipments to India from Western Australia.

Flour for export-certification is examined in these laboratories after samples are drawn at the shipside during loading. If the flour does not conform to Commonwealth Food Specifications the mill concerned is informed and advisory assistance is offered to overcome the problem. Due to changes in flour-mill design, latterly the ash content of export flours has been rising. This is of some concern to the industry.

Soft-Wheat Quality, Relative to Biscuit Manufacture

The work this year was concentrated on two important studies concerning the problem of producing low-protein flour, for biscuit-making.

Influence of Nitrogen-accumulation in the Wheat Plant. The nitrogen content, as a percentage of the dry matter of the plant at flowering, was shown to be closely related to the grain-protein percentage within a given environment. Use could be made of this relationship to predict, up to two months prior to harvest, which would be the low-protein wheat crops in a district.

Particle-size Distribution in Flour. Development of centrifugal-air classification of flours has had a lot of recent investigation, due to the method's practicability for subdividing a commercial flour into classes with vastly differing properties. The smallest particles may have a protein content of up to 20 per cent; the next from smallest particles a protein content of 4–8 per cent, with a large bulk similar to the parent flour. The low-protein fraction is what is sought mainly for use in the biscuit industries.

The particle-size distribution of the various commercial wheat varieties needs study, to assess the potential of portion of the crop for suitability for air-classification methods.

Royal Agricultural Society Wheat Championships

The cereal chemist and the senior cereal-technician acted as judges for the Royal Agricultural Society, in association with a judge representing the New South Wales Flour Millers Council. The Flour Millers Council donated \$600 in prize money to the open wheat-classes which provide for comprehensive testing of the entries.

Despite the record crop in 1966-67, the Show entries were down in total. The early closing-date for entries and the lateness of the harvest were largely the cause. The earlier closing-date was of course related to the early Easter of 1967 and the need even so to provide enough time for the Department's laboratory to mill and bake the entries.

New Equipment

The Cereal Section received funds from the Commonwealth Extension Services Grant to purchase a moisture meter and a grain-temperature recorder. The electronic moisture-meter has been needed because accurate measurement of grain-moisture content is fundamental to all cereal-chemical work. The new instrument is as used by the Canadian Wheat Board and widely also in the United States of America. Canada alone has more than 5,000 of these instruments in use, as the officially-approved meter of the grain-handling authorities.

RICE TESTING

Mr D. McDonald, Rice Breeder, Yanco Agricultural College and Research Station spent a period using the Chemistry Branch experimental mill and Amylograph, to test imported crossbreds and promising material in his breeding programme—including his new release. The Amylograph results correlate with rice cooking-time and cooking-quality, and the results have assisted the rice breeding programme.

PESTICIDES SECTION

General

Advances in the application of modern analytical techniques, including gas liquid chromatography (G.L.C.) and thin layer chromatography (T.L.C.), to a wide range of problems associated with use of pesticides have been a feature of 1966-67. This has been made possible by new equipment and increased staff.

Work associated with pesticide residues in or on foodstuffs for domestic consumption as well as for export has notably increased.

Some of the specialized staff are involved in problems associated with formulation of pesticides, and problems relating to compatibility, spray injury, animal dips, etc.

Lindane Residues in Northern Territory Rice

Samples of rice and rice straw grown in the Northern Territory were analysed for the Northern Territory Administration.

Lindane had been applied on two occasions, at rates of 1.11 to 2.67 lb per acre, in the irrigation water. The samples had been collected eight weeks after the first treatment, and air-dried.

Residues ranged from 0.07-0.12 p.p.m. for unhusked rice to 0.20-0.58 p.p.m. for the rice straw; determined by electron-capture gas chromatography. Lindane is soluble to the extent of 10 p.p.m. in water. The residues found may be due to translocation through the root system and/or capillary action.

Stability of Dimethoate Dips for Bananas

Dimethoate dips are being used to prevent incidence of fruit fly in cased bananas entering the M.I.A. quarantine area. Stability of these dips under routine dipping-conditions has been investigated, to determine whether they may safely be used on several consignments of fruit without replenishment. Indications so far, based on G.L.C. analysis, are that the dimethoate content is essentially stable over a period of at least five days. This is not confirmed by evidence in the literature, which states a half-life of five days for dimethoate under similar pH and temperature conditions.

Bio-assay techniques using fruit fly larvae are to be used to substantiate the chemical results, in view of the importance of maintaining complete biological-control.

DDT Residues on Seed Rice

At the request of the Rice Investigations Sub-committee, the levels of DDT residues occurring on seed rice after DDT treatment for pest control, and also the effect of milling in reducing any residues present on treated grain, were investigated. The risk is that DDT-treated seed could be milled for human consumption.

Samples of paddy rice which had been dusted with 2 oz DDT per bushel, and dehulled and milled samples, were analysed.

Analysis by G.L.C. showed that residues (36.5 p.p.m. DDT) on unmilled seed were greatly reduced by milling. Partial milling (1 minute, 400 g.) reduced residues by 50 per cent to 18.3 p.p.m. DDT; and normal milling (4 minutes, 400 g) reduced them by about 90 per cent to 3.4 p.p.m. DDT.

There does not appear to be a permitted F.D.A. tolerance for DDT residues on rice (December, 1964), but it is clear that the milling operation greatly reduces any hazard which might exist for humans.

Dieldrin Poisoning in Poultry

Reports of poultry-mortalities in a fowl-run, sprayed thoroughly with dieldrin two years previously, led to dieldrin-residue examination of samples of soil, omental fat and ingesta. Residues found were: in the soil, 2.4 p.p.m.; in the omental fat, 89.6 p.p.m.; and in the ingesta, 22.5 p.p.m.

Presumably the fowls had ingested the dieldrin present in the soil over a period of two or three weeks, to levels causing mortalities. The incident underlines the care essential with poisonous substances where animals are involved.

DDT and Endrin Residues in Cottonseed Products

Because of wide use of DDT and endrin as cotton-protectants, the possible residue levels in cotton seed products used in animal production were investigated.

Samples of commercially-milled oil, meal, hulls, offal and lint screenings representing the 1966 Narrabri Crop, and cottonseed from commercial and experimental crops with known spray-history, were examined for DDT and endrin residues. All samples showed each residue. Commercial cottonseed showed higher residues than did experimental crops, due to the greater number of sprays and the applications after "boll-burst".

Because of risk of contamination of animals being fed some of these products, further experiments are to be set up to investigate residue levels from this source in various species of animals.

Dieldrin Residues in Eggs

An experiment involving external application of dieldrin to laying-hens has been completed. Treatment comprised single applications of $\frac{1}{2}$ oz 0.05 per cent dust or 2 oz 0.5 per cent emulsion per bird. Egg-yolk was analysed for dieldrin residues at various intervals after treatment; using electron-capture G.L.C.

Maximum residues occurred about fourteen days after treatment in the case of each formulation; 4.1 p.p.m. for dust and 2.6 p.p.m. for emulsion. Egg-yolk and body-fat, seventy days after treatment, still contained appreciable residues.

No dieldrin residue is permitted by United States of America authorities, and dieldrin is not recommended by this Department for use on poultry.

Hexachlorobenzene Residues in Eggs

Following rejection of consignments of frozen egg-yolk by United States of America authorities, significant quantities of the fungicide hexachlorobenzene were found in this product.

Hexachlorobenzene normally is routinely-applied to seed-wheat before sowing, to prevent bunt disease in the crop. Rate of application is usually 1 oz of a 30 per cent product per bushel. Residues in the exported frozen egg-yolk were found to range from 0.13 p.p.m. to 2.0 p.p.m.

Apparently, treated seed is being fed to poultry, either directly or in a diluted form with other untreated grain or in commercial poultry feeds.

A survey of available poultry-feeds from seven firms showed hexachlorobenzene residues ranging from 0.01 p.p.m. to 0.10 p.p.m., and it seems probable that this may be the main source of egg yolk residues. Determinations of hexachlorobenzene were made by electron-capture G.L.C., and confirmed on occasions by T.L.C. techniques.

An experiment is to be conducted to ascertain the levels of residues arising from feeding treated wheat in a feed mixture to laying hens.

New, Clean-up Techniques for Fats for Residue Analysis

A new, simplified technique has been developed in the Chemistry Branch to clean up fats for residue analysis. It will be reported in detail in an appropriate scientific publication.

The apparatus is relatively inexpensive, and the process requires a minimum of supervision and is essentially quantitative.

Investigation of Sheep Dips

Influence of breed on uptake of insecticide from the dipping fluid has been further investigated, in conjunction with Glenfield Veterinary Research Station.

Four small flocks of sheep (Merino, Dorset Horn, Romney Marsh, and Border Leicester) were identically showered with a commercial diazinon emulsion. Preliminary examination of wool samples after the showering indicated that similar amounts of diazinon were deposited on the fleeces of the Merino, Dorset Horn, and Romney Marsh sheep, whilst a small amount was deposited on the Border Leicester sheep.

Closer examination showed that the diazinon deposits were not evenly distributed down the wool fibres. On the Merinos more diazinon was located on the tip of the wool fibre and less on the portion near the skin, whereas on the British breeds more diazinon was found on the wool near the skin and less near the tip. A likely explanation is that the compact Merino fleece, with the outer dirt-wax crust, tended to prevent penetration of the dipping fluid, whereas the fleece of British breeds did not.

Laboratory experiments showed that when greasy wool of each breed was teased out to allow free circulation of the dipping fluid between fibres, the fineness of the fibres and the amount of wax on them were most important factors affecting uptake of diazinon.

Miscellaneous Problems

The miscellaneous problems investigated included: TMTD spray injury to apricots; Panogen treatment of wheat; mineral oil contamination of peat moss; DDT residues in soil surrounding P.M.G. cables treated for ant control; dimethoate residues causing off flavour in oranges; lindane residues in Hungarian Millet toxic to budgerigars; and residues in canary seed.

Fruit Residues

Azinphos and Carbaryl Residues on and in Apples and Pears. Forty-six samples from a survey of commercially sprayed apples and pears from Victoria, Tasmania, and N.S.W. were analyzed for residues in the peel and in the pulp, by standard colorimetric methods.

Maximum residues found were: Azinphos 0.18 p.p.m. in the peel and 0.10 p.p.m. in the pulp (F.D.A. tolerance 2 p.p.m.); carbaryl 0.09 p.p.m. in the peel and 0.07 p.p.m. in the pulp (F.D.A. tolerance 10 p.p.m.).

The results indicated some slight translocation into the fruit, with these two pesticides, but values less than 0.05 p.p.m. in the pulp have doubtful significance.

Mercury: (a) Phelam Residues. Very low mercury residues from phelam sprays have been reported from several sources. The following brief investigation was made to test these reports.

One, two, and three applications of phelam at the rate of 1 lb per 100 gallons (0.0015 per cent mercury) were made to Granny Smith apple trees during the growing season. Intervals between sprayings were 9 and 15 days respectively. All samples were harvested nine days after the third spraying. Rainfall from the first spray to harvest was only 15 points.

No detectable residue was found in whole fruit samples from each of the three treatments. Peel of the fruit which received three sprays was found to contain 0.001 p.p.m. mercury.

From these results it seems that use of phelam greatly reduces the risk of mercury residues on apples. However, this advantage would have to be considered in terms of the biological efficiency of phelam.

Mercury: (b) Accumulation in Apple Trees. Apples and bark from trees in an orchard under prolonged observation and experimentation by the Biology Branch were analysed for mercury. For the past ten years the trees had been sprayed with phenyl mercuric chloride after harvest, each autumn but one, and never during the growing season.

The samples were collected by the biologist. He identified and separated the various bark samples and related each to a definite number of spray applications. The bark samples showed progressive mercury content, according to number of sprays. Residues in apples from these trees showed no significant difference from those in controls which had never been mercury sprayed.

Details of this investigation are to be submitted for publication.

Mercury: (c) Collaborative Analyses with Interstate Laboratories. A collaborative analytical test to determine mercury residues in apples is in progress, among eight government analytical laboratories throughout Australia.

As no suitably sprayed commercial sample was available, apples were dipped in a suspension of phenyl mercuric chloride of appropriate concentration. Four replicate samples of the dipped apples have been sent to each laboratory, the laboratory to use the analytical method with which it has had most experience.

WATERS

Water Testing Services

Demands on the Department's water testing services continued strong, despite easing of the drought in some areas.

At Rydalmere Headquarters. A total of 639 samples submitted by landholders and the Water Conservation and Irrigation Commission were analyzed and reported on, as to suitability for stock, irrigation, and rural domestic use.

Service demand on headquarters at Rydalmere has to a degree been effected by the availability of on-the-spot country testing, but Rydalmere continues to receive samples direct from landholders and deals with problem waters forwarded from Regional centres for specific study.

Water testing and interpretation of analytical data have increased in sophistication in recent years. The interpretation and advice are necessitating more informed and in many cases more detailed reporting to landholders.

At Regional Centres. Electronic and chemical facilities for water testing and soil pH testing have been available at Regional centres since 1960. This year, 3,220 samples of water and 425 soils were examined as an on-the-spot service to landholders, bore drillers, irrigation equipment organizations, and others.

The value of the Department's decentralized service is exemplified by quoting from the Regional Supervisors' reports.

The Supervisor for Western Agricultural Region (headquarters at Orange) reports that since the widespread drought of 1964-65 there has been considerable bore sinking throughout the Region to locate alternative and supplementary water supplies for irrigation, stock, and domestic purposes. Farmers, bore contractors, estate agents, and irrigation machinery agents are making greater use and relying more on the decentralized water testing service. There has been consequent need for specialized advice in many cases.

In the southwest, at Dareton on the Murray River, there has been concern over the rise in salinity levels in the river due to flowback of farm drainage waters and from other sources. This has resulted in demand for quick, local information relative to the level of total dissolved salts and chloride levels.

In the Mid-coast and Hunter Region the continued demand for testing services has shown that most farmers are aware of and appreciate the service. The value to them has been in avoiding needless expenditure on development of unsuitable sources, and in avoiding damage to crops and soils from use of salty water. The growth of demand for the service in this Region is illustrated by statistics showing that 107 water samples were tested in 1961-62, and 842 in 1966-67, with peak figures of 1,150 in 1964-65 and 1,274 in 1965-66, the drought affected years.

Continued and increased demand for the decentralized service since its inception is reported from all other centres where testing facilities are available. This in fact is causing extension personnel some concern as to amount of their time involved, and suggesting that review of the staffing of the service would be necessary if the demand continues to increase.

Research into Water-testing Equipment and Methods

Since 1960 a Departmental/commercial co-operative-research project has been in progress, towards development of electronic-equipment for use by landholders.

In the original concept the equipment was to assess the salinity-status of stock- and irrigation-waters, and to be especially valuable where the salinity-status is variable over short periods as is so with many tidal rivers whose waters are used for irrigation. Subsequently the research has been centered on development of a soil-moisture indicating-device for location in the active-root zones of crops, to determine the need for irrigation consequent on depletion of soil ratio as a measure of the intensity-factor, a linear relation-moisture and development of stress conditions.

The salinity meters and soil-moisture indicating devices (soil-moisture blocks) are now widely used in all States of Australia, and in New Guinea and Fiji. They are very useful at farmer-level for the aforementioned purposes.

This year the potential of the soil-moisture blocks in control of irrigation has been demonstrated at Gundagai; with asparagus, sweet corn, and peaches. The demonstration, a co-operative project by Departmental officers and a grower-organization, has been a success and will continue to the coming harvest-season.

Unsolicited reports of the success of the equipment with a number of crops have been published in the press and rural-interest magazines, and by private communication to the inventors.

Research into possible improvement of the equipment has been progressing since its introduction, using information from users as to any suspected malfunction or failure.

Extension Services by the Waters Section

Addresses were delivered by invitation to the Federation of Australian Nurserymen's Association 23rd Annual Conference at Canberra, and to the Australian Society of Dairy Technology 8th Biennial Convention at Terrigal, by the senior officer of this Section. Lectures were delivered also to an Irrigation School at Macksville and a Field Day at Kyogle. Refresher courses in water-testing, and interpretation of analytical data, were conducted at Wagga and Leeton. A televised demonstration on water-testing was given at Orange.

REGULATORY AND GENERAL

Revision of Stock Foods and Medicines Act

Further activities towards completion of revision of the Stock Foods and Medicines Act involved Departmental Committee meetings and joint-consultations with manufacturers' representatives; to iron-out points of difference involving quality-standards, desirable levels of feed-additives, and manufacturers' practical problems in maintaining consistent quality within prescribed limits.

Regulatory Analyses

Stock Feeds. Quality of a number of stock feeds from various areas (Armidale, Newcastle, Goulburn, Wagga) has been checked by chemical analysis. Legal action resulted; specifically in the case of undeclared use of urea. Warnings were given where minor breaches were detected.

In meat meals, excess fat and bone was the principal cause of concern. The problem of maintaining desirable standards has been featured in discussions with industry representatives, in framing the revised Act.

Stock Medicines. Illegal inclusion of hexachlorophene in a registered stock-lick, resulting in death of cattle, was detected and reported. The manufacturer was prosecuted.

Furazolidone (a specific for control of Salmonellosis and some other poultry infections) was in one sample found to be grossly deficient on registered formulation. There had been numerous complaints that the product was ineffective.

Expansion of activities in this field is envisaged consequent on proclamation of the Act under revision.

Dairy Industry Act. Analyses pursuant to the regulations of this Act included the examination of butter, cheese and other milk products and margarine.

Survey of Feedstuffs

Analyses involving determination of major and minor elements in 200 samples of raw materials of vegetable and animal origin used in blended stock-feeds have been completed. This is to allow appraisal of nutritional levels of

these elements in Australian feedstuffs. Results are being prepared for publication.

Choline in Poultry Diets

Studies are continuing to establish recommended levels of choline in poultry diets (involving test-feeding and analyses of feed-ingredients and mixed diets). These are in collaboration with the Department's research staff at the Seven Hills Poultry Research Station. One paper on certain aspects has been submitted for publication.

PHYSICAL CHEMISTRY SECTION

Free Energy and Soil Potassium

Interpretation of soil-potassium behaviour in terms of free energy, and of somewhat more empirical relationships which have been developed as a result of limitations of the more basic free-energy approach, has assumed increasing importance in the thoughts of the world's soil chemists.

It is argued that a soil's ability to supply a crop's needs with respect to a particular nutrient is governed both by the amount of nutrient present and its degree of availability. Full description of the potassium-status of a soil must incorporate both of these factors; commonly referred to as the "quantity factor" and the "intensity factor". By using ΔK an experimental quantity associated with free-energy measurements, as a measure of the quantity-factor, and the activity-ratio as a measure of the intensity-factor, a linear relationship between these factors is obtained. These quantity-intensity relationships are being studied to assess the extent to which they fulfil the needs.

The data from free-energy measurements made on some 200 soil-samples from the potash research programme of the Chemistry Branch are being processed, and studied with particular reference to publications on similar work done interstate and overseas. The Chemistry Branch findings are consistent with those of other workers, and of particular interest because of the wide range of characteristics of the soils selected for the work.

The Large Spectrograph

Work continued on trace-element analyses of rock phosphates from various sources. About 200 samples were analysed this year and some 13 trace elements were investigated.

Some wood-ash and plant-samples were also analysed on the large spectrograph for trace elements.

Atomic Absorption Spectrophotometry

Phosphate and Plant-sample Analysis. Analyses of rock phosphates and superphosphates for Ca, Mg, K, Na, Mn, Cu, Zn continued. About 250 samples were analysed. Also, about 2,000 plant samples were analysed for those seven elements.

Method- and Equipment-improvements. Several method or equipment-improvements were made. A new high-intensity copper lamp and auxiliary power-supply were acquired, to replace the old hollow cathode lamp. There is now a very much more stable signal from the lamp and a big increase in sensitivity. Previously, for 1 per cent transmission the concentration of copper in solution was 0.5 p.p.m. Now it is 0.1 p.p.m.

Since most plant-samples yield solutions with a copper content of 0.5 p.p.m. or less, the sensitivity-increase has greatly increased the degree of accuracy of the results.

Another improvement was by discontinuing making dilutions from the stock-solution for the various elements except calcium and magnesium. Dilutions were continued for Ca and Mg, as Strontium had to be added to overcome interferences.

For the other five elements the stock-solution was used and the sensitivity of the instrument reduced to accommodate the larger concentrations. The methods of reducing sensitivity were to reduce the length of the flame path by rotating the burner head.

The length of the flame path normally is 10 cm and when fully rotated 90° is 0.5 cm. Thus, up to twentyfold decrease in sensitivity can be had by this method. If this were still too sensitive, another wavelength of the emitted spectrum was selected which gave less absorption of light. This latter method was used for potassium. Now, up to 4,000 p.p.m. potassium can be determined directly on the stock solution.

Near the end of the year, a digital indicator unit was acquired for the spectrophotometer. Instead of observing a needle on a galvanometer, reading in "% Transmission" to obtain the results, this new unit shows digital numbers and reads both absorbance or directly in p.p.m. in solution.

Previously, to obtain p.p.m. in solution the “% Transmission” readings from the meter had to be converted (by tables) to absorbance. The absorbance-readings for the range of standard solutions were plotted on graph paper against the corresponding p.p.m. value. From the graph the absorbance-readings for the unknown solutions were transformed into p.p.m. readings. All of this is now redundant. Direct p.p.m. readings are obtained.

Also, if the needle-signal were unsteady the operator was sole judge of when to take the reading (extremely difficult with an oscillating needle). On the new unit the reading is done for the operator. He has only to observe numbers.

Two features incorporated to increase accuracy and stability of the reading are: (i) operate lamp and amplifier at 285 cycles per second in a noise-cancelling synchronous demodulation-system (this corrects random noise); (ii) an averaging-system whereby 5 or 10 readings of the one solution can be taken, the unit automatically averaging these readings and displaying the answer (this reduces long-term noise and frees the operator from deciding the most significant figure).

Additional muffle-furnaces and water-baths were provided to handle increased numbers of samples.

PLANT NUTRITION SECTION

Co-operative Work with Proprietary and Similar Organizations

Corrosion Associated with Canned Vegetables. Australian Iron and Steel Pty Ltd asked the Chemistry Branch to do co-operative work in relation to a corrosion problem associated with vegetable-canning. In recent years, in Australia and other countries, corrosion has tended to occur on the inside of the containers of some canned products. There has been some suggestion that the occurrence has coincided with increase in use of nitrogenous fertilizers.

Experiments have been designed, in co-operation with the Division of Plant Industry, to create a set of conditions wherein variable amounts of nutrients will be available to

French bean plants during the growing season. These plants will be harvested, for canning and chemical analysis, to detect the possible relationship between fertilizer-practices and can-corrosion.

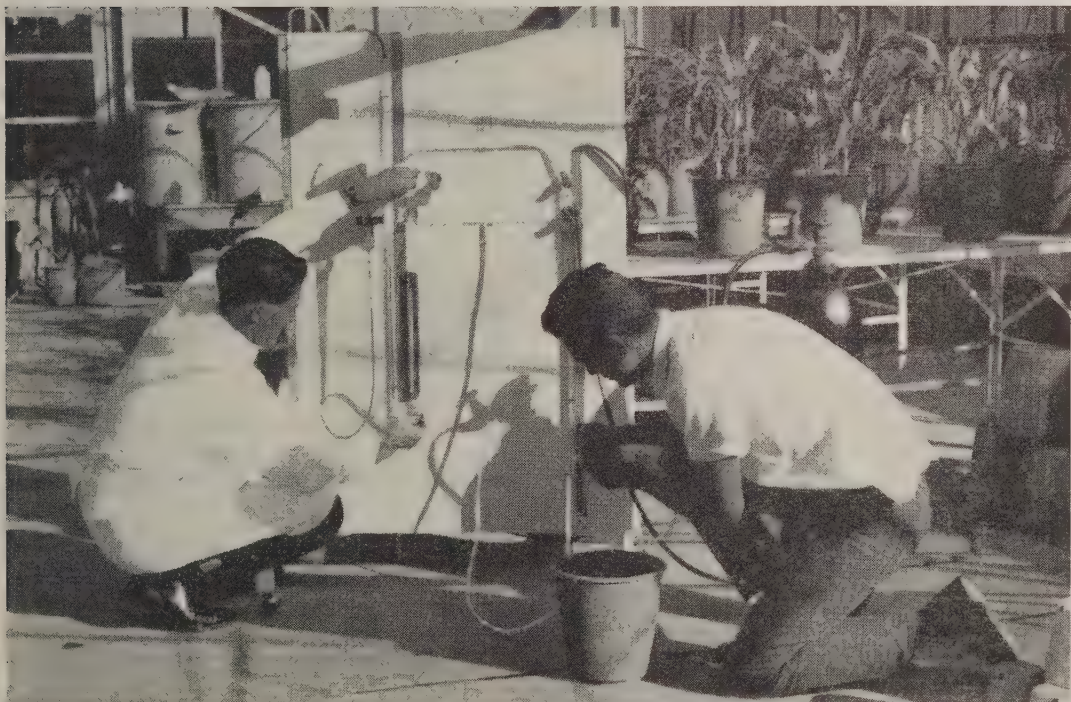
Nitrogen-enriched Coal. Samples of nitrogen-enriched coal have been tested in the laboratory and glasshouse in co-operation with Australian Coal Research. Reports were received from India that this material had been compared with other nitrogenous fertilizers for residual action and that the results indicated nitrogen-enriched coal had good potential.

Mainly because of this Indian work, Australian Coal Research made experimental batches of nitrogen-enriched coal and supplied some to the Division of Science Services. As a first step it has been tested, in pots, against ammonium sulphate. The results are recorded:

Treatment	Nitrogen yield per pot (milligrams N)	
	1st cut	2nd cut
Nil	6.02	27.9
Ammonium sulphate 4 cwt to the acre	11.30	201.8
Nitrogen-enriched coal (N equivalent to 4 cwt ammonium sulphate)	5.36	31.5
Nitrogen-enriched coal (N equivalent to 8 cwt ammonium sulphate)	5.15	41.0
Nitrogen-enriched coal (N equivalent to 12 cwt ammonium sulphate)	6.50	42.1

From that tabulation it is seen that nitrogen-enriched coal compared unfavourably with ammonium sulphate, at least in the short-term. Currently it is being tested, in pots, against nitrogenous fertilizer with a higher residual-action.

There is a good deal of interest in this material as a potential fertilizer. Some good deposits of coal are not being worked, due to freight-costs. If nitrogen-enriched coal has some fertilizer value, there might be an outlet for coal produced in some of the rural areas.



Maize zinc-deficiency research by Chemistry Branch

Zinc-deficiency in northwestern maize crops has possibly been aggravated in some of the black soils by anhydrous ammonia. Apparatus (above) has been made by Chemistry Branch for pot-experiments; to compare anhydrous ammonia and sulphate of ammonia effects, at equivalent nitrogen rates and with or without sulphur or gypsum at various rates (see p. 112)

Deficiency-work, with Australian Fertilizers Limited. There has been evidence from time to time that zinc deficiency or other marginals may be aggravated on some black soils in the northwest of New South Wales by use of anhydrous ammonia. Sulphur's role as a nutrient and as an acidifying agent also needs investigation.

Australian Fertilizers Ltd has supplied the Chemistry Branch with \$200 worth of equipment and \$400 by way of services of an assistant to promote appropriate glasshouse-work.

Special apparatus has been constructed to deliver measured quantities of ammonia gas into pots. Experiments have been established to compare the effect of anhydrous ammonia with ammonium sulphate at equivalent rates of nitrogen, with or without sulphur and gypsum at different rates.

Fertilizer practices on maize and sorghum in the north-west seem likely to be influenced during the coming season by the results of these experiments.

Other glasshouse-experiments also have been undertaken, to test seed-treatments; a range of zinc compounds in conjunction with zinc sprays. Trials of rates and forms of zinc sprays have also been established. Several species are being tested for susceptibility to zinc deficiency.

Data are now available from field trials established in the northwest in co-operation with a District agronomist in November, 1966, in the study and correction of maize zinc-deficiency.

New Method to Determine Elemental Sulphur in Sulphur-fortified Superphosphate

Elemental sulphur in sulphur-fortified superphosphate was formerly determined by a laborious procedure requiring firstly the determination of sulphate-sulphur present, then oxidation of the elemental sulphur.

To study the fineness of elemental sulphur in sulphur-fortified superphosphates, a rapid technique to handle the large number of determinations had to be developed.

A simple and accurate method was developed, by using the Soxhlet procedure usual in extraction of fats from feedstuffs. Little modification of the standard Soxhlet procedure was needed apart from replacement of the fat-extracting solvent (ether) by the sulphur-solvent (carbon disulphide).

The new method has given very reliable results when used for sulphur-fortified superphosphate made by either wet- or dry-mix methods, and for elemental-sulphur fractions extracted from sulphur-fortified superphosphates.

The following tabulation shows the recovery of sulphur, mixed in the laboratory with 0.5 grams of ordinary superphosphate. Of interest, the flowers of sulphur used contained an allotropic form partly insoluble in carbon disulphide. This resulted in only about 60 per cent recovery when the pure sulphur was extracted but complete recovery when mixed with superphosphate. Apparently, and very fortunately, superphosphate has a catalytic-type effect in converting all of the elemental sulphur to a carbon disulphide-soluble form.

Wt. of S added	Recovery	
	(g.)	Percentage
0.200 g.	0.199	99.5
0.500 g.	0.5035	100.7
1.500 g.	1.502	100.1
4.00 g.	4.010	100.1

Magnesium in Banana Leaves

Some eight years ago the Division of Horticulture drew attention to yellowing in banana plantations. There was serious discolouration and it was possibly the cause of death of some sections of plantations. Over the years, samples have been submitted from healthy and affected bananas by officers of the Division of Horticulture. The symptoms have been described by these officers in the *Agricultural Gazette of N.S.W.* and have been recorded as a problem since the 1920s.

There may be some variations of the symptoms. Over many years, samples received and analysed in the Chemistry Branch have shown the affected leaves to contain very little

magnesium by comparison with healthy leaves collected from the same plantation. The following tabulation, referring to samples collected over this period, shows levels of magnesium in healthy and affected leaves.

Date	Locality	Percentage Magnesium	
		Affected	Healthy
1964	Mooball	0.058	0.268
1964	Murwillumbah	0.083—0.044	0.236—0.302
1964	Dungay	0.078—0.168	0.272
1965	Mooball	0.10—0.18	..
1965	Crabbies Creek	0.5 —0.11	..
1965	Crabbies Creek	0.08—0.12	..
1965	Crabbies Creek	0.08—0.11	0.216
1965	Crabbies Creek	0.175—0.190	0.259
1965	Mooball	0.150	0.256
1966	Piggabeen	0.055—0.107	0.347
1966	Billinudgel	0.055	0.212
1966	Terranora	0.07	0.194
1966	Billinudgel	0.069	0.294

Notably, all but one of the healthy samples contained over 0.2 per cent magnesium whereas all from affected plants contained less than 0.2 per cent.

Magnesium nitrate spray has been suggested. Other methods of control also are being studied by the Division of Horticulture.

Citrus Nutrition Survey

A three-year survey in citrus-growing areas has been completed. The results are being processed.

The survey has indicated abundant incidence of magnesium deficiency on the central coast. Corrective methods have been developed.

Over the drought years there was also a chloride-toxicity problem in the M.I.A. and less so in some other districts. Recommendations were made in some areas, to change from the chloride to sulphate form of potash fertilizer.

Extension officers recommended also a change in irrigation practices, to control toxicity by leaching-irrigations. Chloride-analyses in the last season were substantially less frequent than in the previous year, and it would appear that fertilizer and irrigation changes have reduced the chloride levels.

Iron Deficiency in Carnations

A grower brought to the Division of Science Services, carnation seedlings said to be representative of 5,000 plants not marketable. Iron-deficiency was diagnosed and was corrected in the seedlings, in pots, within a week—by addition of iron chelate. The treatment was better where iron chelates were mixed with zinc and manganese chelate.

The grower had been propagating the carnation seedlings in a mixture of perlite peat and sand, and had induced iron-deficiency by adding calcium hydroxide to the medium.

Potash Deficiencies

Samples have been collected from the Division of Plant Industry potash and phosphate experiments on pastures at Berry, in the Illawarra. The three sites sampled are very potash-deficient.

Blossom-end Rot of Tomatoes

In a co-operative experiment on blossom-end rot of tomatoes with Biology Branch, a wide range of treatments including high rates of superphosphate, sprays, calcium forms, and soil-treatments with lime, are being tested. Also some analyses have been done, on the lower-half of the fruit from selected plots, to evaluate fruit chemical-analysis as a diagnostic tool for the condition.

Pasture Investigations re Livestock Nutrition

A range of pasture samples from a Division of Plant Industry experiment at Hawkesbury Agricultural College have been analysed. There are significant differences between liveweight of lambs grazed on different species. The analyses involved nitrogen fractionation, carbohydrate, crude fibre and ash.

Petiole Nitrogen and Cotton Yield

Effort has been made to develop a method to determine the nitrate-nitrogen in cotton petioles. Previously a sulphonic acid method was used, but results were variable. Ammonia is now determined, after its reduction by Devarda's alloy. Some of the early determinations for nitrate-nitrogen in the petiole are being rechecked.

Good correlation seems likely between nitrate-nitrogen in the petiole and the yield of cotton. This is a co-operative project with Division of Plant Industry.

Fertilizer Act Revised

An extensively revised Fertilizer Act has now been passed by Parliament. Since the drafting of the original Act the importance of nutrients other than nitrogen, phosphorus and potash has grown. Research has highlighted the importance of sulphur, magnesium and trace elements. There have also been the changes in fertilizer-technology and handling.

The new Act takes account of these developments. It also simplifies and makes consistent the manner of expression of nutrient elements in fertilizers, by expressing each nutrient in terms of the element. Previously only nitrogen was expressed as the element; phosphorus and potassium were expressed as the oxide.

A change-over period of about two years has been suggested to enable growers and manufacturers to adapt to the new requirements. Regulations to implement the revised Act are in preparation.

Training of Officer from Overseas

Mrs Chalerm Sri Vagragupta, Colombo Plan Fellow from Thailand where she is Chief Chemist of the Agriculture Department, is undergoing three months' experience in the Plant Nutrition Section with special regard for determination of minor elements.

SOILS SECTION

General

The Soils Section work falls naturally into three divisions; viz., advisory analyses for field officers and landholders; investigations aimed at soil-fertility assessment; and soil surveying. There have been increased demands in each.

The number of samples analysed and reported on for advisory purposes increased again this year. Soil tests for available manganese and toxic levels of that element, and assessments of soil-structure stability, have been added to the range of tests carried out.

Investigational work has been expanded to include the examination of citrus soils, to relate tree nutrient-status and soil tests. A survey of "available" potash levels in coastal and tablelands soils has also begun.

Requests for soil surveys continue. Systematic soil-survey of the higher rainfall areas, and also some extension into selected areas of the wheat belt would be advisable if staff shortages were overcome.

Advisory Analyses for Landholders and Field Officers

The number of samples again increased this year, to about 2,900, due in part to increased interest in soil analysis.

The analyses done were as in previous years, with the addition of structure-stability tests and a faster method of estimating non-exchangeable-available potassium (N.E.A.P.). The nitric acid method formerly used involved a day's work for a batch and could be done only on a quite limited number of soils. The newer method is now used on all soils thought to be potassium-deficient.

A recorder installed on the Beckman spectrophotometer (see "Physical Chemistry Section") is saving considerable time in reading phosphates and the cations, calcium, magnesium, sodium and potassium.

Investigations into Soil-Fertility Assessment

(a) Phosphorus Studies: (i) Pasture Soils

North Coast Trials—Grafton. Four hundred and sixteen soil samples from trial sites down to Ladino White Clover and *Lotononis bainesii* were tested for Bray No. 1 soluble-phosphorus. Most of the trials are now in their second year and each has had an annual maintenance-dressing of superphosphate as well as the initial application.

Soil-test results are indicating the rate of build-up of soil-phosphorus as well as the run-down on the plots receiving "nil" maintenance-dressings of fertilizer. Granite soils seem to have a more rapid rate of build-up than the finer textured "coal measures" soils.

Over 1,000 plant samples were harvested for phosphorus and nitrogen analyses, to be done in the ensuing year. Indications are that applied fertilizer-phosphorus increases the content of total phosphorus in the plant, from less than 0.10 per cent on the "nil" plots to over 0.20 per cent on the 6 cwt per acre plots.

South Coast Trials—Berry. Seven hundred soil samples from nine trial sites (phosphorus and potash) in the Moss Vale-Nowra-Berry area were tested for Bray No. 1 soluble-phosphorus. The samples were taken 12 months after the initial superphosphate application (at rates of 0, 2, 4, and 6 cwt per acre). Plant samples representing harvest of pasture at different times throughout the year were analysed for phosphorus content.

Following a critical project review seven of the trials were discarded and six new ones have been started on more favourable sites. The new sites include one on shale parent material at Berry, one on shale at Nowra, two on shale at Moss Vale, and two on basalt at Kangaloon on the tablelands.

Nitrogen has been added as an additional treatment, in order to study uptake of potassium and phosphorus at two different nitrogen levels.

Northern Tablelands Trials—Shannon Vale Station. Three hundred soil samples from the "Rates of Superphosphate x Stocking Rate (wethers)" trial at Shannon Vale Nutrition Station were tested for Bray No. 1 soluble phosphorus. Following on from the soil phosphorus results obtained in 1965-66, useful information is expected as to the animals' effect on soil phosphorus at three different stocking rates (low, average, and high), grazing on paddocks receiving three different rates of superphosphate applied annually.

(a) Phosphorus Studies: (ii) Wheat Soils

Quadruplicate samples from over 50 trial sites in the central west have been taken for phosphorus analysis before sowing. The wheat fertilizer trials throughout the wheat belt in the central west are part of a collaborative project with Division of Plant Industry, supported by funds from the N.S.W. Wheat Industry Research Committee.

Soil test results for eight different extractants were obtained and are now being processed statistically to determine the degree of relationship between grain yield and the soil phosphorus test figure.

(b) Potassium Studies

Glasshouse Millet Trial. Plant analyses from this trial were completed. Final publication of all data from this work is awaiting completion of statistical analyses.

South Coast Trials. Due to drought and other factors the first year results were disappointing. Seven of the nine trials have been abandoned, and six new ones established.

Grazing Trial at Glen Innes. The samples from the Shannon Vale grazing trial were analysed for exchangeable potassium. The results will be compared to results of analyses on samples taken five years hence.

U.P.S.E.T. (series—R.K.) and P.U.F.T. Analyses of samples from U.P.S.E.T. (R.K.) and P.U.F.T. continued, for exchangeable and non-exchangeable available potassium.

Physico-Chemical Studies. These studies have been continued using available data from the glasshouse trial. They will be published when statistical analyses have been completed.

South Coast Potassium Survey. Analysis of soils taken in this survey has been completed and publication of the results is under attention.

(c) Manganese Toxicity Studies

The manganese toxicity trial at Terranora ended in this, the third, year. The results of analyses of the second and third year crops are now being statistically examined.

Manganese levels in the soil and in leaves in the third year showed no significant variation from those of the first and second years. Toxicity symptoms were well pronounced again during the winter, but there were few symptoms in the spring even though the soils and the leaves showed much higher manganese content at this period.

Seemingly the initially applied lime is still correcting toxicity but its effect is fading. On the other hand, the acidifying effect of sulphate of ammonia was reflected in the decreasing pH values towards the end of the trial, at higher sulphate of ammonia rates. This effect is especially pronounced where the higher lime rates were applied initially. The yields were considerably lower in 1966, due probably to the unfavourable weather for beans.

A new manganese toxicity trial was started at Alstonville Tropical Fruit Research Station in April, 1967. Two separate trials are being conducted. *In the first*, lime and various magnesium compounds have been applied to correct manganese toxicity and magnesium deficiency. Sulphate of ammonia has been applied at four levels. *In the second*, the effect of chloride on manganese toxicity is being studied on three species important on the far north coast; beans, vetches, and *Glycine*. Chloride was applied at four levels, as potassium chloride.

Increasing chloride levels are thought to have a marked effect on manganese levels of plants. The experiment at Alstonville will run for three years.

(d) Citrus Nutrition Project

Initial work has been done on soil tests for citrus nutrients. In the three main citrus growing areas (Sydney, Gosford, and Murrumbidgee Irrigation Area) a preliminary survey was completed to select five or six citrus groves from each area, among those currently being sampled for leaf analysis.

An attempt will be made to relate soil nutrient levels to leaf levels, fertilizers applied, yield, and other measurements. Soil samples for analysis will be collected from the selected orchards annually in the spring.

In the Sydney area, five orchards already have been sampled. This was in November, 1966, and analyses are under way.

(e) Nitrogen Research in Central West: (i) Wheat Soils

1966-67. Initial ammonium-nitrogen, nitrate-nitrogen, and moisture determinations were completed on the 41 trials sown in Condobolin and Cowra districts. Total nitrogen analyses were done on all samples.

About 20 of these have been analysed by aerobic and anaerobic incubation procedures to determine nitrifying capabilities.

All trials were harvested but statistical analyses have yet to be done, to determine the correlation between amount of nitrogen in soil and response to added fertilizer.

1967-68. Samples from 34 trials from Condobolin area, 21 from Cowra area, and 1 from Yanco Agricultural College and Research Station have been received and analysed for nitrate-nitrogen, ammonium-nitrogen, and moisture. About 20 trials have been analysed for total nitrogen.

New Method for Nitrate Determination. Standard solutions were used to find a method of reduction of nitrate. The new method gives higher recovery and greater reproducibility than the previously used one.

(e) Nitrogen Research: (ii) Samples from District Agronomists

Initial mineral-nitrogen analyses, and both incubation tests, were done on a number of trials set up by District agronomists. Since no correlations are at hand the soil values are usually compared with the agronomist's recommendation as well as with yield results.

(f) Available Potassium Survey, Coast and Tablelands

Development of Method. A more suitable method of determining non-exchangeable available potassium (N.E.A.P.) has been developed. (It involves shaking a soil/cation exchange resin/water mixture end-over-end at 80° for 24 hours, separating the soil and resin and leaching the latter with hydrochloric acid before determining potassium on the flame photometer. An important development from the original reference was the continuous shaking. This was largely responsible for the much improved reproducibility of results.) Four hundred and twenty soils from the potassium work were tested by this method later in the year and show promise of good correlations with plant response.

Survey re Available Potassium, Coast and Tablelands. Survey of available potassium in the soils of the coast and tablelands has been started. A pilot area was chosen wherein to test sampling procedures, data collection methods, and other aspects. This area (the Crookwell-Shoalhaven-Moruya-Sydney block) has been divided into units based on rock type and soil. The units will be further divided into land use classes, excluding areas too rugged for agricultural development.

Each unit will be sampled to survey its potash status. At present the units are being discussed with officers of the Division of Plant Industry, for comment and advice before sampling begins.

Soil Surveying

Clarence Valley. The Clarence Valley soil survey has been the major activity. Most of the work this year was concerned with finding factors governing distribution of the major soil groups of the area.

The surveyor is now able to bring out a revised report on the Clarence Valley soils and their distribution. Physical and chemical criteria affecting land-use cannot be attempted because of the lack of trained staff. Some time will elapse before this phase of the study may even start.

This intensive Clarence Valley survey has been favoured by outstanding co-operation by officers of other Government agencies, notably Dr D. C. van Dijk of the CSIRO, Brisbane, and Mr R. K. Rowe of the Soil Conservation Authority, Victoria. Exchange-visits have been made and much knowledge of soil-genesis and distribution gained.

Papers on Clarence Valley work were submitted to the A.N.Z.A.A.S. Congress in Melbourne and the Ninth International Soil Science Congress in Adelaide.

Other Activities. These comprised advisory field-visits in the central and southern tablelands and southwest slopes, and were particularly helpful in making intra-regional correlations of soils.

YANCO RESEARCH LABORATORY

The Rice Chemist

Soil Testing. More than 600 soil samples from the Irrigation Districts were analysed, for fertilizer-recommendations for rice. The analyses were done in collaboration with Australian Fertilizers Ltd who did parallel analyses using an automated procedure. Some samples were also analysed by both methods, to check repeatability over the required range of test-values.

In the 1967-68 season Australian Fertilizers Ltd will do both sampling and analysis, and send some of the samples to Yanco for check-analysis.

Results of the soil-testing and fertilizer-trial grain-yields in 1965-66 are still under discussion, a further report from the Biometrician having been received in May, 1967. The 1966-67 trials have produced similar results.

Field Trials. Field trials were conducted at Yanco to assess the effect of plant-density and also mid-season application of nitrogen, on grain-yields. Plant densities of 1½, 3, 6, and 12 inches between plants were used this year, compared with the 1, 2, 4, and 8 inches in 1965-66 which gave no significant differences in grain-yield.

This season the three closer-spacings gave yields of 4 tons to the acre of paddy, but the 12-inch spacing was closer to 3½ tons to the acre.

Topdressing-trials showed increased yields of ½ to ¾ of a ton to the acre, of grain, for the application of 70 lb of nitrogen; with little yield-difference between applications of fertilizer during the first two weeks in January. But untreated plots gave consistently higher yields than control plots of adjacent trials, indicating considerable spread of nitrogen even in almost stationary water. This was confirmed by higher levels of residual soil-nitrogen in unplanted areas between plots, compared with similar areas external to the trial.

Grain Quality. Grain quality, by determination of amylose content of milled grain, was assessed for a number of varieties from the Yanco collection; and also on some of the previous year's district-samples. Samples from the 1966-67 season have also been taken for quality-assessment.

Fruit Nutrition

Peach-nutrition Investigations. The leaf-analysis determinations, started in the 1965-66 season in the M.I.A., were completed this year. These were investigations towards developing leaf-analysis such that it may be used routinely as a guide in diagnosing peach tree malnutrition.

A tentative sampling-procedure and a tentative set of leaf-nutrient concentration-standards were compiled from a review of the literature. The procedure and standards were then tested under M.I.A. conditions in a survey extending over the two seasons.

The survey covered orchards with a history of above-average production, good management, and absence of malnutrition symptoms, and orchards showing visible symptoms of malnutrition. Measurements were also made of errors associated with certain aspects of the sampling, preparation and analytical techniques. Some alternatives in the sampling-procedures were compared.

The tentative standards have been found valid for M.I.A. Golden Queen peach trees, in both seasons. All major M.I.A. peach-soils were represented. No evidence was found of any need to modify the standards for Stanford, Gaume, or Boyce varieties. The tentative standards were clarified at two points. Visible symptoms of nitrogen-deficiency were found to occur at a concentration of 2.4 per cent, and visible symptoms of manganese-deficiency at 20 p.p.m. A peach-block with a mean manganese-concentration of 21 to 30 p.p.m. will most likely contain a few trees expressing visible deficiency symptoms.

From fertilizer-trials on Sandmount sand it appeared that mature trees on these soils may need at least 1.5 lb nitrogen per tree per annum, to maintain them at "normal" nitrogen-levels.

The survey did not show any need for potassium fertilizer on red-brown earth soils. However, both nitrogen and phosphorus fertilizers were shown to be needed on all soils, and manganese on soils of the Griffith district with free-lime concretions in the rooting-zone.

The sampling-studies showed that for mid-season varieties, sampling need not be confined to shoots borne on fruiting-wood. It was also shown that if ten leaves are collected from each of twenty trees in an apparently-uniform block, then on average the percentage error for macro-nutrients will not exceed 10 per cent and for micro-nutrients and sodium will not exceed 2½ per cent. If samples are neither washed nor refrigerated on the day of collection, then errors of the order of 10 per cent can be anticipated.

The sampling-studies confirmed that improved laboratory-precision is needed. No evidence was found of need to make allowance for diurnal variations. Dipping the whole sample in non-acidified detergent proved to be the most suitable way of removing dust and soil contamination, but it would not completely remove leaf spray-residues. Leaf powder was satisfactorily re-dried at 105° C for one hour before taking subsamples for analysis.

On the basis of this work, recommendations have been made regarding the form of a routine analytical-service for growers in the M.I.A.

Botany Branch

NATIONAL HERBARIUM, ROYAL BOTANIC GARDENS AND ALLIED ACTIVITIES

NATIONAL HERBARIUM

The National Herbarium services were maintained at a high level. Botanical staff-establishment increased by one and is at full strength.

Funds are awaited for working plans and the construction of a new Herbarium building. Sketch plans and estimates were prepared in the preceding fiscal year. The building is an urgent need.

Botanical Research

"Contributions from the New South Wales National Herbarium." Vol. 4, No. 1, of this series was published. It contained nine research papers and The Index and Title Pages to vol. 3.

The "Flora of N.S.W." Series. Four sections of the "Flora Series", comprising data on seven plant families have been published. Two more sections of the Flora Series have gone to press and a third awaits final editing.

Part of the manuscript for the Flora Series Nos 202-203 (families Cyatheaceae and Dicksoniaceae) has been prepared for publication.

Projects Completed or Proceeding. Two more papers, "The Status and Relationships of the Australasian Species of *Typha*" and "New Species in *Eleocharis*" have been completed.

A phytochemical survey of a number of Australian species of *Acacia* has been almost completed, as a joint project wherein the chemical analyses have been done by Dr D. G. Roux, Chief Research Scientist, Leather Industries Research Institute, University of Rhodes, South Africa, while the botanical aspects have been dealt with here.

A large section of the monograph of the *Acacia decurrens* group of species has been completed pending further investigations which are continuing.

Research into relationships amongst species of *Eucalyptus*, and into the genus *Casuarina* continued. A contribution on the latter, to be published in W. M. Curtis' "The Student's Flora of Tasmania", is in press.

A study of the Australian species of *Typha* ("Cumbungi" or "Bulrushes") has been completed. This included determination of chromosome numbers, comparison of Australian and exotic material, revision of the classification and nomenclature, and consideration of the unusual floral and inflorescence structures of the genus. The two native species are troublesome weeds of irrigation channels.

Material of Australian Restionaceae on loan from the Herbaria at Kew and Berlin has been studied. This has enabled the correct naming of many of the little-known species. Extensive collections of species of the Restionaceae, gathered in Western Australia, have largely been identified and are being incorporated into the Herbarium.

Revision and chromosomal survey of the Australian species of *Veronica* and allies are proceeding. This is a collaborative project, with Professor F. Ehrendorfer, of Graz, Austria. The limits of the three closely related genera in this group are being re-evaluated. Several undescribed species have chromosome numbers different from those of allied species with which they have previously been confused. Recent collecting has added much to information on the distribution and variation of the species.

A treatment of the family Proteaceae is being prepared for "The Flora of New South Wales". Material about the genus *Conospermum* is well advanced.

A study of *Galium* (family Rubiaceae), partly in collaboration with Professor F. Ehrendorfer, is well advanced. Three visits were made to Canberra to consult with Professor Ehrendorfer on *Galium* and *Asperula* taxonomy matters to establish selfing tests on several species of *Galium* at the CSIRO and observe the results. Some positive self-pollination evidence was obtained.

Manuscript of a paper using results of a study of the Type Specimens of Australian species described by the French botanist M. Gandoger has been almost completed.

Preliminary investigation of the genus *Acronychia* (family Rutaceae) is proceeding and will yield a short paper.

The large family Cyperaceae is being studied. Treatment of the genus *Eleocharis* has been completed. Study of the genus *Cyperus* has started.

Preparation of material on the family Lemnaceae (the "Duckweeds") continued.

In the course of studies of native and naturalized grasses of New South Wales the Brisbane Botanic Museum and Herbarium has been visited regarding taxonomy problems of *Paspalum commersonii* and related species, and some other genera and species which extend into Queensland.

In continued studies of the Papilionaceae *Bossiaea*, *Crotalaria*, and *Lotus* received special attention. Type specimens of species described by F. von Mueller and in the Melbourne National Herbarium were matched with specimens in the Sydney National Herbarium and the latter will now serve as reliable standards for application of Mueller's specific names here.

Further evidence has been gained on the identity and distribution of *Xerotes mucronata* (now referred to the genus *Lomandra*) which was described supposedly from the Port Jackson district. By consultation with Dr Choo of the University of Western Australia it has become apparent that the species was known there but under an incorrect name.

Studies on the marine and freshwater Algae of Australia continued. Many enquiries have come from commercial enterprise about availability of seaweeds of economic value on the Australian coasts, but knowledge of their seasonal and geographic distribution is still inadequate to forecast when and where they can be had in commercial quantities.

The Blue-green Alga *Anacystis cyanea*, recorded for the first time in Australia last year and implicated in livestock losses, has now been identified in water samples from many inland dams. There it has again apparently killed various types of livestock.

Re-examination of the Herbarium collections of *Argemone*, the "Mexican Poppy" group, showed that two species are naturalized in New South Wales. As was recorded last year, the common species here is *A. pchroleuca*, not *A. mexicana*.

as previously thought. There is in fact no known authentic record of *A. mexicana* occurring here. Some material from the northwestern slopes has been found to be *A. subfusiformis*, a South American species not previously recorded in Australia. It has been present in this country for over fifty years but has not become as widespread as *A. ochroleuca* though similar and sometimes growing in association with the latter.

Identity of a *Paspalum* species cultivated on the north coast as "*Paspalum regnellii*" came under suspicion. As the Herbarium contained no authentic collections of this species for comparison, material was forwarded to the United States National Herbarium, Washington. There it has been identified as *Paspalum wetsteinii*. Another closely related but then unknown species was forwarded at the same time and identified as the true *P. regnellii*.

Limited subclover culture has been undertaken to discover means by which the named varieties commonly grown in New South Wales can be differentiated in the Herbarium. Although there are some morphological distinctions the period of first flowering (a field character) remains an essential diagnostic character. Certain colour details previously thought transient are still apparent after a few years in preservation. This and pubescence of certain parts are the most useful discriminatory characters in the dried specimens. Colour photographs of the cultures have been taken and the same plants preserved for future assessments.

Mr T. C. Fuller, California Department of Agriculture, Sacramento, has drawn attention to cleistogamous florets in *Amphibromus neesii*, "Swamp Wallaby Grass". These cleistogamous grains are received in seed of *Trifolium subterraneum* imported into California from Australia. Examination of the collections of this native grass in the Sydney National Herbarium has revealed that two of the twenty-five sheets display similar cleistogamous florets.

"Swamp Wallaby Grass" normally inhabits the wet margins of lakes and ditches but may marginally spread into somewhat drier ground. Specimens of plants which clearly had been rooted in mud showed strong culms and no cleistogamous florets. The two showing the florets seemed to have come from drier ground. These bore a number of very fine, narrow-leaved shoots with some inconspicuous florets concealed at their base.

Field Investigations. During a period in the Grafton and Gibraltar Range district, several rare ferns were collected from rainforest areas and material of two undescribed species of legumes were obtained.

In the Rankin Springs district, wood blocks and voucher specimens of *Acacia* spp. were obtained for current joint research with Dr Roux of the Leather Research Institute, South Africa.

Pre- and post-session botanical excursions associated with the ANZAAS Congress in January, 1967, to Wilson's Promontory and West Gippsland, provided field observations and the collection of special herbarium materials. Two species of *Eucalyptus* (*E. simmondsii* from Wilson's Promontory, and *E. corticosa* from south of Walhalla) were found—not previously known from eastern Victoria; also the rush *Juncus effusus*—the first authentic record of it in Victoria. Mt Macedon and Hesketh were also visited, to observe living *Acacia nano-dealbata* trees.

Professor L. D. Pryor, of the Australian National University, was accompanied in the Narrabri and Paroo River districts to investigate several problems in *Eucalyptus*. A species newly discovered ten years ago has now been found widely distributed in the northern Pilliga Scrub, particularly on deep sandy soils known as "Sand monkeys". It will be described and discussed in a paper at present in preparation. An apparent new species of *Juncus* was also found in the Pilliga district. An *Atriplex* collected near the Paroo River also appears to represent a new species.

In the Carnarvon Range in Central Queensland, an isolated area of sandstone and basalt, of great botanical interest, a close relationship was apparent between the flora there and that of sandstone country in New South Wales.

In the Mt Colong and Bindook areas of the Warragamba Dam catchment, material of several undescribed species of *Veronica* currently under study were collected.

Around Oberon and Wombeyan Caves, observations were made on the distribution of species of *Eucalyptus* and other groups.

Professor F. Ehrendorfer, of the Institute of Systematic Botany, University of Graz, Austria, was accompanied on visits to the Blue Mountains, Warrumbungle Mountains, Liverpool Range, and Howes Valley districts, for field study and collection of species—in particular the genera *Veronica*, *Parahelbe*, *Galium*, and *Asperula*. Herbarium staff are collaborating with the Professor in revising Australian members of these genera.

Botanists spent three days in the Tamworth and New England district with apicultural officers, Division of Animal Industry, to indicate to them the most useful field characters for discrimination between species of *Eucalyptus*. Whilst there the botanists collected study material of various plant species. A new species of *Conospermum* was also field examined for the first time.

The cytotaxonomist during a Western Australian field trip collected material of the Restionaceae and other groups for chromosomal studies. All of the Western Australian genera of this family and the great majority of the species were collected. The variation and distribution of the species were also observed. Duplicate sets of specimens were obtained, for this Herbarium and the Western Australian Herbarium. Some of the species were not previously represented in either Herbarium.

Material was also collected in Western Australia for cytotoxic study of members of the families Proteaceae, Xanthorrhoeaceae, and Xyridaceae, and of the fern genus *Cheilanthes*.

A grant from the CSIRO Science and Industry Endowment Fund and further aid from the Western Australian Department of Agriculture made the Western Australian visit possible.

In co-operation with the Fauna Protection Panel several areas on the New South Wales north coast were field-studied for information on vegetation. This was for the Sim Committee of the Lands Department. The resultant large collection of plant specimens included some previously unknown and some rare plants. Amongst them was a new species or subspecies of *Isopogon*, a *Boronia* sp., and a *Prostanthera* sp.

In collaboration with the Forestry Commission's Research Section, Coff's Harbour, north coast rainforests were studied. Valuable observations were made on the characters and distribution of rainforest species. Over 200 specimens were collected. Many were rare plants.

Living plants of *Xanthorrhoea quadrangulata*, a South Australian species whose identity had been somewhat uncertain, were studied near Adelaide.

In Condobolin district, with the District Veterinary Inspector, a botanist examined the field occurrence of the blue-green Alga, *Anacystis cyanea* in dams. The Alga had apparently been causing poisoning of stock and poultry. Outbreaks of the poisoning were reported from several centres during autumn.

Professor M. Zohary of the Hebrew University, Jerusalem, was escorted on a visit to Cronulla and the Royal National Park to study salt-tolerant plants of special interest to him.

Dr P. T. Kondratenko and Dr P. N. Kibalschich, of the Vilar Institute (U.S.S.R. Research Institute for Medicinal and Aromatic Plants), Vilar, Moscow, were escorted on a collecting trip to Putty and Mt Tomah to obtain seeds and leaves of ecotypes of *Solanum aviculare* and its close relatives for cultivation and chemical analysis in Russia. Plants of this group contain medicinal drugs of some importance, and are being experimentally cultivated in Russia.

Plants New to New South Wales

Thozetia racemosa was collected at Iluka, north coast. It is the only species of the genus and was previously known only from Queensland. Thus it is a new generic and species record for New South Wales. The plant is a rainforest climber of the family Asclepiadaceae.

Lepidium foliosum was found on rocky shores near Jervis Bay. This cross-like native herb has been reported from the south coast, but this is the Herbarium's first authenticated record of it in New South Wales. It is well known on the coasts of Victoria, Tasmania, South Australia and Western Australia.

Osteospermum clandestinum (*Tripteris clandestina*), "Tripteris", a South African member of the Compositae, was recorded from between Minore and Dubbo, and from two miles north of the Dundee Creek School on the Boggabri-Willala-Ghooli road. These are the first records of it in New South Wales. It was naturalized in Western Australia prior to 1845 and later spread to South Australia. In Western Australia it was reported in 1925 to be palatable to stock but tending to invade wheat crops. There has been no later report to suggest a serious problem.

Tetratheca glandulosa var. *glandulosa* was obtained from Mt Budawang in the Braidwood district; the first record of it in New South Wales. It occurs in Victoria and Tasmania.

Sisymbrium thellungii, a cruciferous weed, was found in the Ashford district. It is a South African species not known elsewhere as a weed though it could become a minor weed of cultivation.

Sporobolus pyramidalis was received from Pumpenbil, near Tyalgum, far north coast, where it is apparently naturalized. It was cultivated at the Botanic Gardens, Sydney, in the 1930's, but is not previously known to have become naturalized.

Cyperus laetus ssp. *oostachys* was found near Lawson. It is a native of South America (Brazil, Argentina and Paraguay). This is the first record of its occurrence in Australia.

Ipomoea polymorpha, collected in the sandridge country west of Milparinka in 1955, has only recently been successfully identified. It occurs in tropical parts of Australia but was not previously found in New South Wales.

Ipomoea angulata was collected at Eungella where it seems naturalized. It is a native of tropical America, occasionally cultivated in gardens.

Rare Species and Extensions of Range

Acacia bauerlenii was collected between Woolgoolga and Grafton. The only previous specimen was in 1895 from New Italy, north coast.

Acrostichum speciosum, an aquatic fern which grows near mangrove swamps, was collected on the Esk River and at Iluka. These localities represent southerly extensions of the known range.

Baeckea crassifolia, a small native shrub with attractive flowers, was found at Kamarah, near Ardlethan. Previously in this State it has only been collected at Balranald, though fairly common in parts of western Victoria and in South Australia.

Bothriochloa ewartiana was received from Walgett. The only previous New South Wales specimen in the Herbarium came from Lightning Ridge.

Corybas fordhamii, a rare terrestrial orchid, was collected at Port Macquarie. Previously it was known only from Nambucca Heads.

Cyperus procerus was received from Lismore where it was forming a heavy growth in an alluvial area. This tropical species, a potential weed, extends into Queensland. In New South Wales it has previously been recorded only from Kyogle.

Daviesia brevifolia was collected at Rankin Springs. This is the first New South Wales specimen of this legume in the National Herbarium, though recorded in 1893 for the "southern interior" by Moore and Betcher.

Eriachne glabrata, previously known only from the central coast near Sydney and Newcastle, was obtained from several localities on the north coast.

Eriachne pallescens was collected three miles SSW. of Sandon River, some 20 miles east of Grafton, in forest. This is the second specimen of the grass received at the National Herbarium from New South Wales. It occurs in coastal Queensland at least as far north as Cairns, and on adjacent off-shore islands.

Goodenia havilandii, previously recorded only from Cobarr, Shuttleton and Gunderbooka Range, was collected at Wumbulgal, southeast of Griffith.

Kennedia retrorsa was again collected at Mt Dangar, near Gungah, in the Goulburn River valley. It is known only from this locality where it was obtained in 1904 and 1912.

Lomandra elongata was collected at two sites on the north coast. This species had only been recorded twice from New South Wales; from other districts.

Rhynchospora brownii, previously represented in this Herbarium by only two specimens from Port Jackson and New England respectively, was obtained from the north coast.

Schoenus pachylepis, not previously known from north of Broken Bay, was found on the north coast.

Uncinia flaccida was obtained from Gloucester Tops. Previous records of it were from Yarrongobilly in 1933, and Barrington Tops in 1934.

Uncinia tenella was collected at Gloucester Tops. Its most northerly previous record was Mt Wilson.

Withania somnifera, "Winter Cherry", was recorded from Glendonbrook Creek, Myall Reserve. The only previous record was from Vacy in 1949.

Plants Poisonous to Humans

Information compiled last year, on selected plants regarded as being the more likely to cause poisoning in humans, was re-organized and mimeographed. This was because of various requests received from the Toxicology Branch, Commonwealth Department of Health, the Poison Centre at the Royal Alexandra Hospital for Children, the Baby Health Centre of the New South Wales Department of Health, and others. A limited number of copies have been distributed to those and other interested bodies. Each botanist in the Herbarium staff now has a copy at home for ease of reference in case of being contacted in emergency by hospital authorities. The Hospitals Commission has the private address and phone number of each botanist.

Special Identifications

Specimens of tropical legumes and of exotic grasses (mainly *Paspalum* spp.) grown at the Grafton Agricultural Research Station from seeds collected in South American countries by a Principal Agronomist of the Division of Plant Industry, have been identified. The legumes and grasses are being trialled for north coast pasture improvement.

The horticultural herbarium collections of *Acacia* in the United States National Arboretum, Washington D.C., U.S.A., were identified at the Curator's request.

Identities of several native orchids were subject of a statement requested by the Fauna Protection Panel which now administers the Wild Flowers and Native Plants Protection Act.

Plant specimens were reported on for the Police Department in connection with a case of indecent assault.

Nomenclatural data and notes on plants of Norfolk Island and Mauritius mentioned in journals of early Australian administrators were prepared for a Newcastle University lecturer in history.

For the Mitchell Library, a coloured plate of a Norfolk Island plant, one of an unpublished folio of original illustrations of Norfolk Island Plants (from the Dixon collection), prepared about 1794, was identified as depicting *Freyinetia bauerana*.

About 200 herbarium specimens, comprising representatives of all the ferns and fern-allies cultivated in the glasshouses and greenhouses of the Botanic Garden, Adelaide, were identified.

Botanical Exchanges

Botanical Specimens. The system of exchange with other Australian and overseas institutions continued, but work-pressure hindered the outgoing of specimens. This aspect of National Herbarium work is much in arrears.

From overseas institutions 1,701, and from Australian institutions 1,426 specimens were received, whilst 514 specimens were sent to 12 overseas institutions and 59 specimens to three Australian institutions.

Photographs of Type-Specimens. Seven hundred and fifty-five photographs of Type-Specimens of ferns and fern-allies were received on an exchange basis from the Smithsonian Institution, U.S.A. These, photographed in various European and American herbaria, are a very valuable addition to the Pteridophyte collection.

Field Collections and Seed Exchange. Twenty-four packets of seed of native plants were supplied for transmission to Mexico, and seven packets to the University of Pretoria, South Africa.

Packets (111) of seeds of native plants which have been in store for years and of doubtful germinating capacity were supplied to a native plants enthusiast (Mr A. Blomberry), who has offered to test and report on their germination. The information should prove a guide to the longevity of seed of various plants for exchange purposes.

Checking of the available viable seed for exchange purposes is proceeding, for compilation of a new seed-list for overseas distribution.

For a chromatographic survey of all species of *Bursaria*, to determine which species contain significant quantities of the drug aesculin (used in sunburn-creams), material was supplied to the Division of Wood Technology, Forestry Commission. The survey indicated that two common species contain the highest percentages of the drug. The tests were also of taxonomic interest and suggested segregation of a new species.

Stylidium duplicate material was forwarded to the Palynological Laboratory, Solna, Sweden, for pollen studies by Dr Bronker, Louvain, Belgium.

Pollen samples from many Australian species were supplied to Professor G. Erdman of Stockholm, and Professor J. Rowley, of Amherst, U.S.A., for palynological study. They were particularly interested in Proteaceae and Restionaceae. Their results will be valuable in this Herbarium's studies of the two families.

Australian Algae collections were sent to McGill University, Montreal, Canada, there to further an investigation into the adsorption of heavy Strontium by the alginates from various Algae.

Ninety-eight packets of seed from overseas institutions and thirty-nine from other Australian institutions were received for propagation at the Royal Sydney Botanic Gardens. Forty-two plant species were collected and presented by members of the staff as seeds, living plants, or other propagules.

The Botanical Collector. The Botanical Collector spent forty-one days in the field collecting seed, herbarium specimens for record and exchange, and other plant materials specifically required for botanical research in the National Herbarium and to meet requests from other botanical institutions.

Extended trips were made to the northern tablelands and northwestern slopes districts, the Rankin Springs and Parkes districts, and the South Coast. Shorter trips were made to various sites on the Blue Mountains, to the Mt Yengo and Mt Wareng areas, the Glen Davis and Capertee Valley districts, the Royal National Park, the St Mary's district, the Central and Upper Colo, and Castle Cove.

An assignment of interest was collection of a quantity of native flowers for air-dispatch to the Harrogate Horticultural Society, England.

Botanical Materials Borrowed or Loaned or Donated

Borrowed. Material of Australian Restionaceae in the Botanisches Museum, Berlin, was received on loan for identification and use in comprehensive studies of this family. Among the material are Type-Specimens of species named by E. Gilg. Further Type-Specimens of Restionaceae were obtained on loan from the Royal Botanic Gardens, Kew.

Herbarium specimens of *Veronica* and its allies were borrowed for study from the Herbaria at Melbourne, Brisbane, Adelaide, Perth, Canberra, and Christchurch; of *Acacia* from Melbourne, Brisbane, and Perth; of *Bossiaea* from Brisbane; of *Oxylobium* from Melbourne; and of *Galium* from Melbourne, Adelaide, and Perth.

Loans. Plant specimens were loaned to the following institutions and botanists for study: Dr N. T. Burbidge, CSIRO, Canberra; Mr A. Dockrill, Cairns, Queensland; Division of Land Research, CSIRO, Canberra; the Tracy Herbarium Curator, Texas A. & M. University, U.S.A.; Mrs Petterson, Massey University, New Zealand; Dr R. Carolin, University of Sydney; Dr H. J. Eichler, State Herbarium of South Australia, Adelaide; and Dr S. T. Blake, Botanic Museum and Herbarium, Brisbane.

Donations. Miss Marie Baldwin, of Springwood, donated 460 colour transparencies of native flowers to the Herbarium collection. Mr Riddell, of Hurstville, donated a large collection of specimens, mostly grasses, from the estate of the late D. L. W. Henderson—a former correspondent with the National Herbarium and a diligent and able collector.

Mr E. H. Gordon presented specimens and colour-transparencies of plants, chiefly orchids, to the Herbarium and gave valuable assistance in sorting the orchid collection. Mr

A. C. Beauglehole has permitted Herbarium retention of duplicates of specimens which he had collected in many parts of Australia, including the centre and west of the continent. Many very useful materials and records have thus been added. Mr R. G. Coveny has on several occasions collected and donated material required for cytological study.

General

Visitors. Many notable visitors from overseas and Australian institutions were granted facilities for study at the National Herbarium and/or held discussions and consultations with the staff on matters relating to their particular studies. The details are on record.

Equipment Additions. A Wild M11 Research Microscope in carrying case has been added and has been valuable already in certain field investigations, as well as in regular use for the Honorary Algologist. Drawing apparatus acquired for use with the Wild stereomicroscopes will facilitate production of diagrams of plant-parts. A microfilm reader added to the library is greatly facilitating use of various publications stored on microfilm and microfiche; an increasing number of most valuable reference books, many not otherwise accessible in Australia, are being reproduced and stored on microfilm and microfiche.

A new field-dryer has been of great benefit in securing the good quality of herbarium specimens collected on extended field trips. The Land Rover obtained in the previous year has also greatly facilitated field studies.

Miscellaneous Services. The Director and Chief Botanist addressed the Northern Regional Officers' Conference at Tamworth and the Mid-Western Regional Officers' Conference at Cowra on the "History of the Royal Botanic Gardens in Relation to Agriculture". A talk on the need for conservation of native plant life was recorded for the A.B.C. by Dr J. Vickery. Mr Johnson delivered a review-lecture on "*Eucalyptus* Taxonomy" opening a symposium on "The Genus *Eucalyptus*" at the ANZAAS Congress in Melbourne, January, 1967.

Dr Briggs has been appointed a member of the Systematic Botany Committee of Section M of ANZAAS in place of Dr Vickery. Dr Vickery had served in the Committee since its inauguration in 1946. Mr Johnson has been appointed to the Parks and Reserves Scientific Committee set up by the Minister for Lands and Mines to advise on resources and requirements for conservation of flora and fauna throughout New South Wales. He served also, in the Sim Committee, also set up by the Minister for Lands and Mines. Mr Johnson, Special Botanist, has been elected President of the Linnean Society of New South Wales for the term 1967-68.

Dr Tindale gave evidence involving the identification of plant material, as an expert witness in a court case at the Sydney Quarter Sessions. Mr D. M. McGillivray gave expert evidence as a crown witness in a case about the alleged sale of protected native plants without a licence.

Botanist consultations were provided to the State Planning Authority, on harbour foreshore preservation.

The Director of the new Captain Cook's Landing Place Museum was assisted in relation to botanical and historical relics of Captain Cook's voyages, and this country's early botanical explorers.

Several manuscripts, original drawings and specimens that had been owned by J. H. Maiden, one-time Director of the Botanic Gardens, were lent to the Australian Museum for display during the centenary celebrations of the Royal Society of New South Wales.

ROYAL BOTANIC GARDENS

The Gardens were in good condition during 1966-67, especially during the spring blooming season. They continued to attract a great deal of public interest, with massed seasonal displays of colour and the increasing restoration and developmental work.

Heavy rain occurred on several occasions. It caused some floodings and damage in the low-level areas.

Plantings, Constructional, Restorative and Allied Improvements. Improvements included reconstruction of walling, and laying of cut sandstone paving, along the eastern perimeter of the main pond in the Lower Garden; paving and landscaping the surrounds to the smaller "Twin Ponds" west of the main pond; re-siting and restoration of the Henry Kendall Memorial; re-formation and kerbing of roads and footpaths and the related regrading of adjacent areas in continuation of earlier work; demolition and replacement of the derelict lath-house in the glass house section; continuation of replacement of expanded galvanized water services with copper

services; extension of power and light and telephone communication to various work depots; de-silting of the waterway leading through the Upper and Middle Gardens; installation of electronic misting-units for plant propagation; extension of exhibition-plantings along the Macquarie Street boundary north of the main entrance, and in established areas elsewhere; and improved descriptive plant-labelling by means of engraved multi-layered plastic.

Fountains and Statues. The Morshead Memorial Fountain under construction at the Shakespeare Place entrance to the Gardens was completed. It was unveiled by His Excellency Sir Roden Cutler on Sunday, 27th November, 1966, when handed over to the Government by the Fund Foundation.

Installation of the water circulatory-system at the Phillip Fountain in the Garden Palace Grounds adjacent to the Macquarie Street entrance has been completed. This fountain is now giving a fine display after many inactive years.

The Crippled Children's Fountain on the forecourt facing Macquarie Street, for some time non-functional due to water-filtration and recirculation troubles is again operating.

The "Mare and Foal" statue has been re-erected in the Lower Garden following completion of the recasting for repair of damage caused last year by vandals.

Nursery and Glasshouses. Expansion of range and quantity of material under production continued, with propagation and development of local and overseas introductions. Liaison and exchange of material with kindred institutions has contributed significantly.

In the glasshouses public displays of selected flowering species were arranged—including Anthuriums, Bromeliaceae, Calceolaria, Orchidaceae, Hippeastrum and Saintpaulia as well as a wide range of foliage plants with Begonias, Caladiums and Codiaeums prominent.

Additional indoor species introduced from various sources included Begonias, Bromeliads, succulents and cacti, and orchids. The latter included a wide range of tropical native species from North Queensland and New Guinea. These are new to the collection and enhance the botanical value.

Unfortunately the deteriorated condition of the several very old glasshouses heavily penalizes the general appearance of this important display area.

The usual provision of plants and floral decorations for Parliament House, and for Government offices and stands and official rooms at the Royal Agricultural Society's Easter Show was sustained. Considerable decorative material was supplied also for the Government Reception to President Johnson in the Art Gallery.

Landscape Designing. Apart from directing the landscape works associated with general development of various areas, including works approved by the Centennial Park Supervisory Committee for restoration and development of Centennial Park, the major projects were preparation of plans for: extension of plantings along Macquarie Street and the southern boundary inside the Main Entrance from the Domain (compensatory for losses during Cahill Expressway construction); modification and development of areas contiguous with the site for the proposed new National Herbarium; and paved seating-areas adjoining the main ponds and also the "twin ponds" west of these in the Lower Garden.

Site-inspections were made and plans and/or reports were prepared for landscape-treatment of a new cemetery for Albury City Council, the Point Frederick Cemetery for Gosford Shire Council, the historic St John's Church, Parramatta, the Rachel Forster Hospital, the proposed parklands for Tamworth and Inverell Municipalities, the Pagewood and Parramatta East Primary Schools, and for Hawkesbury Agricultural College.

Advisory visits were also made for landscaping for other authorities; including Vacluse House Trust, Prince Henry Hospital, Mosman and Camden Municipal Councils, Newcastle City Council, and the Main Roads Department.

A third series of lectures was delivered by the Senior Landscape Designer to University of Sydney post-graduate students of town-planning. Day-long schools on landscaping were provided for the Agricultural Bureau of New South Wales, and talks were given to West Tamworth and Inverell Rotary Clubs.

The Turf-Demonstration Planting. This planting, started in 1963, was further developed this year. Species have been added, increasing to fifty-two the total number of varieties displayed. These plots remain an attraction to visitors and have been invaluable in bringing before the public the wide range of species suitable for turf. Notably too, the plots have induced a well-known, long-established commercial organization to explore the prospects of commercial development and marketing of selected species in the demonstration.

Garden Study Tours. The Royal Botanic Gardens is receiving the attention of an ever-increasing number of student groups undertaking botany study-tours. Some 500 in groups came from the University of New South Wales and a similar number from the University of Sydney Botany School. Numerous school classes from primary to secondary level also visited the Gardens for guided tours and other instruction.

Visits to the Gardens were also part of the itinerary of the 170 delegates attending the National Conference (in Sydney) of the Australian Institute of Parks and Recreation and about 100 New Zealand and other delegates en route to the National Rose Convention in Melbourne.

Vandalism. Vandalism continued to be a problem. Plant labels and garden seats were removed and damaged and statues were disfigured or broken. A particularly disturbing incident was the bending of a number of the vertical copper sprays of the Morshead Memorial Fountain shortly after it was handed over.

Staff. Lack of trained staff is an increasing problem. Staff continue to be lost not only by retirement but by resignation.

Mr J. Thomas, N.D.H., was appointed Assistant Superintendent and took up duty on 18th November, 1966. His practical and administrative experience has been gained in several positions in England, Rhodesia, Sardinia, as well as his time in Australia.

General. Superintendent Mr W. R. Watson has been appointed to a subcommittee of the Horticultural Advisory Council of the Ryde School of Horticulture to draft proposals for introduction of two advanced courses, one on Landscape Design and the other on Park Administration.

The Australian Institute of Parks and Recreation (formerly the Australian Institute of Park Administration) held its 39th National Conference in Sydney in August, 1966; under the sponsorship of the Department, and this Branch in particular. The attendance of 170 delegates from all States of the Commonwealth and New Zealand, was a record. Mr W. R. Watson, Royal Botanic Gardens Superintendent, was elected Vice-President.

THE DOMAINS

The Outer and the Inner Domains were satisfactorily maintained and some improvements were effected.

The more noticeable improvements were the condition of the grassed surface of the Domain playing fields and other grassed areas, following mechanical aeration and fertilizing; restoration and planting of the area east of the Public Library, disturbed during building extensions; and extensive removal of dead limbs from many of the majestic Moreton Bay fig trees lining Hospital Road and elsewhere in the Domain.

Domain Baths. Contractors to the City Council have begun preliminary site work for construction of the Domain Baths following demolition of the old buildings. A limited area of the Domain has been made available by the Royal Botanic Gardens and Domains Trust as a work area for the contractors. This has been fenced off temporarily from the public.

General. Car parking on a limited area of grassed surface in the Domain was permitted during the two weeks preceding Christmas; also on the date of the Government Reception to President Johnson, at the National Art Gallery. The grassed areas were used also for the recurrent annual parades and assemblages associated with Australia Day, the R.A.S. Easter Show, the Waratah Sping Festival, Apprenticeship Week, and on other occasions approved by the Trustees.

The Domain playing fields were again used regularly for sporting activities. Following intensive renovation the areas were better able to support the increased use. It is of interest that the areas were subjected to 170 Rugby League, 135 Soccer, and 745 basketball matches.

GOVERNMENT HOUSE

Inner Domain gardening staff maintained Government House Grounds and provided floral decorations for within the building. Some ground improvements were effected. The more important were: kerbing along the eastern alignment of the main drive, modification and renovation of the glasshouse, extension of cut-flower plantings, and removal of dead trees.

ADMIRALTY HOUSE

Royal Botanic Gardens gardening staff maintained the grounds of Admiralty House, the Governor-General's Sydney residence, and provided floral decorations for within this building and Government House, Canberra. The Commonwealth Government recompenses the State.



BEFORE. De-silting and reed-removal at Pond No. 12, Centennial Park



AFTER. The restorative effect at Pond No. 12, Centennial Park

Special funds were again provided for Centennial Park restorative and developmental work. Pond de-silting and reed-removal are part of the overall improvements plan. (see p. 121)

CENTENNIAL PARK (INCLUDING QUEEN'S PARK)

Additional Funds. For the third consecutive financial year the Government provided funds additional to the normal for maintenance. The additional funds were a special \$60,000 vote for restorative and developmental work. The inter-departmental Centennial Park Supervisory Committee spread and completely expended the funds over a series of items.

Maintenance. The general maintenance of the two Parks (Centennial Park 480 acres and Queen's Park 60 acres) is the responsibility of the Royal Botanic Gardens Administration—controlling the Superintendent and staff located at Centennial Park. This staff does all routine maintenance activities (planting, watering, pruning, mowing, road sweeping, attention to fences, etc.) and any developmental projects suited by available equipment. Other work, restorative and developmental, is done by public contract or the Public Works Department or by hired casual labour (such as for cleaning and painting the iron-picket perimeter fence).

Provision of much needed additional modern equipment has eased the maintenance problems. Greater areas of the park are in consequence being opened up and well presented. The floral displays have received commendatory mention in broadcasts and shown on television. General appreciation of the area is indicated by the notable increase of visitors.

Plantings. Many hundreds of trees, native and exotic, raised to advanced stages in the nursery, were planted out in selected areas that require tree growth for landscape effect. Most of the planted out material has grown vigorously. The effect is already changing the appearance of sections of the Park adjacent to the Ocean Street entrance, below Carrington Drive, near the Children's Playground on Oxford Street, and towards the obelisk area.

Together with those planted in the previous year, the total would now be about 1,000 trees.

Buildings. The third (western) block of the old depot buildings was replaced by a modern brick structure. Buildings of the same material have been built on to the eastern end of the southern block (constructed in the previous year) to house an elevator platform and provide further storage. Replacement of the old wooden offices by a new building will proceed in the ensuing year, thus modernizing all structures in the depot area.

Other buildings (shelters, dressing sheds, and toilets) in Centennial Park and Queen's Park, repaired a year ago by Public Works Department, have this year been painted throughout.

Equipment. A further \$10,000 was expended on equipment. Most was absorbed by purchase of the elevator platform used in lopping and pruning amongst the hundreds of large trees in the Park.

The Ponds. To further the overall scheme to de-silt and remove excess reed growth from the ponds, the Centennial Park Advisory Committee allocated \$6,000.

The large pond (No. 5) east of the shelter shed in the centre of the Park was dealt with and the spoil was spread over the low-lying areas of the Gymkhana Ground. The banks were graded and turfed with kikuyu grass.

Pond No. 6, the most northerly and highest in the pond system, is adjacent to York Road which separates it from the Eastern Suburbs Hospital. This pond receives street run-off water from the Waverley Council area through eight points. Excess silting around these entry points over the years had hindered the free flow of water, and reed growth had increased immensely. The whole section was unsightly. Public Works Department has the responsibility to maintain a clear flow at the entry points and exits of each pond, and this year did a large-scale de-silting of the northern portion. The pond is now clear of impeding growth, the depth is greater in the northern portion, and the northern banks have been suitably graded. The spoil was used on a further portion of the Gymkhana Grounds, and to grade the land to the north and east of the pond.

Pond No. 6 is to be used as a reservoir when the irrigation scheme to the riding track and playing fields is installed.

Water Outflow. Last year's report referred to the concrete wall Randwick Council constructed to impede outflow of floodwaters from Pond No. 9, the lowest in the pond system, adjacent to Alison Road. The Court judgment has been given, that the Council had acted without authority. The concrete wall has been demolished.

Car Parking Control. The system started last year—erection of a line of vertical 2-in galvanized pipes—has been completed along the Grand Drive from the junction of Parkes Drive to the entrance to the McKay Oval on the south. And a pipe-and-

chain system has been installed on the southern border of Grand Drive from the Darley Road entrance to the junction of the eastern end of Parkes Drive. The latter system has been most effective, preventing illegal car parking on grassed areas during Randwick race meetings. Further kerbing and guttering along Dickens Drive, in the floral display area, has also helped.

Roadways. Portion of the special vote was used to remake a further section of Dickens Drive and to kerb and gutter; also to resurface Jervois Avenue and part of Loch Avenue to the Ocean Street gates.

A conference on the site, called by the Government Transport Department, considered the problem of traffic movement at the Cleveland Street entrance to the Park. The parallel roads—the exit from the Grand Drive and Lang Road—cause a serious traffic hazard. The Centennial Park Supervisory Committee agreed to the Transport Department suggestion that the road from the Park be made a one-way traffic entrance only. To effect this, outgoing traffic on Grand Drive approaching from the Darley Road entrances would have to continue further north and make an exit by way of Jervois Avenue on to Lang Road. Wider gates will need to be erected at the entrance to Jervois Avenue in the near future when as anticipated one-way traffic flow will operate.

Fencing. The new wooden park-rail fence around the whole of Queen's Park has been completed and painted; also, further sections of the iron-picket fence surrounding Centennial Park, along Lang Road and York Road, have been cleaned and repainted. Broken stone-coping on the latter sections has also been renovated by suitably coloured new stonework or cement repairs.

General. Portion of the Gymkhana Grounds is being prepared as a practice area for the Police Mounted Squad to undertake tent-pegging exercises. In the same area are facilities for dressage activities. A system of permits has been instituted for the latter use of the area. Much of this section of the Park has been low-lying. It is here that the spoil from Ponds Nos 5 and 6 are being used to develop a well-graded surface for general equestrian activities.

Bondi Rotary Club has donated and erected two barbecue sets, set-up near Ponds Nos 1 and 2. These sets will be a guide also to the need or otherwise of installing more barbecues in the picnic areas.

The Model Aeroplane Clubs' activities have been satisfactory on the areas allotted in the previous year. Consideration is now being given to permit the Model Boat Club to use unpowered model-yachts on one of the ponds where these would not be interference to bird-life.

DECENTRALIZED AGRICULTURAL RESEARCH DIRECTORATES

Agricultural Research Institute, Wagga Wagga

WHEAT IMPROVEMENT

Achievements of Institute Varieties

Heron. This variety continued as the most popular in N.S.W. and contributed significantly to the State's record mean-yield (28.0 b/ac). In the 1965-66 season it was sown over 1,273,000 acres and comprised 26.6 per cent of the State's wheat acreage. Currently it is recommended for sowing in Victoria and South Australia, and is widely grown in Western Australia.

Falcon. This hard wheat is recognized as the best combination of yield and quality of any commercially acceptable variety in the southern half of the State. In 1965-66 it ranked second in popularity; sown over 741,000 acres. It is now recommended for early sowing in Western Australia. Because of its many good qualities, Falcon is being used in further crosses. This is with a view to incorporating stem-rust resistance, shorter straw and some degree of "winterness".

Raven. This variety was released in 1961. It is widely grown in South Australia and recently has been recommended for sowing in parts of New Zealand. Because it is prone to frost-damage it is not grown in New South Wales. Raven is being used as a recurrent parent in several new programmes.

Release of the Variety Robin

Following extensive yield and quality-comparisons with Heron during 1961-65 the crossbred K. F. Heron was released to Registered Seed Growers in 1966. Subsequently it was registered and released as "Robin". The first commercial quantities of Robin are expected to be available at the end of 1967 season.

Robin Comparisons with Heron. In 102 trials: Robin was significantly superior to Heron on 36 occasions, significantly inferior on four occasions, and on 62 occasions was not significantly different.

Overall it represents a five per cent yield-improvement over Heron. It has some additional rust-resistance and is two to three days earlier in maturity than Heron. It is a soft wheat with baking qualities equivalent to Heron.

Evaluation of New Crossbreds

Back-cross Derivatives of Heron. Several have been carried forward for further yield-comparisons. Unfortunately, advent of a new race of *Ustilago tritici* able to attack a previously resistant line has led to a decision against its release. Incorporation of additional resistance will be attempted. The new race was found to attack also the donor-variety White Federation 38.

Back-cross Derivatives of Falcon. Two derivatives bearing stem rust resistance from *Agropyron* have distinctly stronger straw than Falcon while equalling it in yield. One of these, designated AR Falcon 28A, is being widely tested with view to release for general cultivation.

Semi-dwarf Crossbred NB Javelin 115.—This has been widely tested in New South Wales and Victoria during the year. It demonstrates a high yielding-capacity superior to Olympic. In a trial under irrigation at Leeton, it yielded 102.8 bushels per acre. This is the first yield trial wherein 100 bushels per acre has been exceeded. NB Javelin 115 is less susceptible to *Septoria tritici* than Javelin.

New Winter Wheats with Soft Grain. These are now entering advanced trials. Some show distinct promise for the irrigation areas. The Victorian variety Pinnacle has been adopted as a quality standard.

Semi-dwarf Wheats

Studies of this group continued. Quality of new introductions have proved much superior, compared with those introduced earlier in the programme.

Heavy spring and early summer rains produced heavy growth and severe lodging in most commercial varieties. A new Claas Columbus autoharvester performed very well and permitted the separation and harvesting of lodged plots with almost no loss of grain.

Experiments showed that lodging reduced by more than 50 per cent the yield in a crop of Olympic, and that this could be largely controlled with the growth-retardant C.C.C. applied with superphosphate fertilizer. Nevertheless it is unlikely that C.C.C. will be used commercially for this purpose in Australia.

Breeding-programme Application of Phasic-Development Studies

The previously reported phasic-development studies have continued. They are now a very important basis of the breeding programme. Winter Minflor, used in previous years, has been shown to be characteristic of the winter wheats which possess a moderate vernalization requirement. The two recessive genes for winteriness carried by Winter Minflor are being transferred to the varieties Heron and Raven.

A study of the three American winter varieties Blackhull, Early Blackhull and Extra Early Blackhull has revealed very striking differences in sensitivity to the short day-length periods. Such differences appear to explain the heading behaviour of these varieties under normal field conditions.

Cytogenetics

Monosomic Work. The monosomic additions of rye (*Secale cereale*) chromosomes to the wheat variety Heron have been obtained and are being grown to produce the disomic additions. Of particular interest in these lines will be their susceptibility-reactions to take-all (*Ophiobolus graminis*). The ultimate objective is to select and transfer resistance to commercial varieties.

A further back-cross in production of a monosomic series in Heron and in Falcon has been made. Monosomic series have been commenced in the lines NBJ 115 and Robin, and also in a semi-dwarf line.

Primitive Barley Crossed with Bread Wheat. It has been found possible to cross primitive barley (*Hordeum spontaneum*) with bread wheat. Crosses have been made to produce chromosome addition lines of barley to wheat.

Intervarietal chromosome substitution lines have been used to study the genetic basis of developmental responses, plant height, fertility, protein content and grain size.

Afghanistan Collections now in Breeding-programme. Following the Institute's participation in a wheat-collecting expedition to Afghanistan in 1965, material has been grown and classified with a view to its evaluation in the wheat-improvement programme.

Wheat Quality Investigations

All the equipment necessary for micro test-baking of early-generation crossbred material has now been installed. Exploratory work to devise a suitable routine-testing procedure will begin as soon as normal routine quality-testing of advanced lines has been completed.

Additional physical dough-testing has been done on lines from the last harvest using the recently installed Brabender equipment.

An investigation of the influence of variables in some major flour-constituents, on the results given by this equipment, has been pursued with particular emphasis on gluten maturity. Results so far throw considerable light on interpretation of flour-quality results given by this testing method.

Only preliminary work has been done so far on the influence of variations in the level of damaged starch in flours. A full programme on this aspect will be resumed shortly.

OAT IMPROVEMENT

New Varieties

Cooba's Popularity. Since its release in 1961, Cooba has rapidly increased in popularity. By 1965-66 it had become the leading variety in New South Wales, comprising 22.6 per cent of the total oat acreage. Currently it is recommended for dual purposes in all agricultural regions.

Crossbred F.B.D.F. Released as Coolabah. The crossbred previously known as F.B.D.F. again did well at all testing centres of the central and southern districts. It has recently been registered and released under the name Coolabah.

Over the past six years Coolabah has outyielded all other varieties for grazing and grain in trials sown during April and later periods. Its outstanding feature is fast early-growth, a quality greatly valued by graziers. In only two situations is Coolabah bettered by other varieties; by Cooba for early sowings and by Avon when grain only is desired.

Promising Crossbred, Superior to Avon

Of the advanced crossbreds, one (Avon x Osage) yielded particularly well. It returned the top grain-yields at Trangie, Leeton, Condobolin, and Temora. Over the past three years it has outyielded Avon by about 6 per cent. Oat-processors class Avon x Osage as markedly better than Avon in milling quality and approaching the excellence of Belar.

Phasic Development, and Injury from Grazing

Of the many varieties examined, Ballidue, Irwin, Kent, and Avon have the most rapid stem-elongation and are therefore highly susceptible to damage from grazing. Such damage affects grain-recovery yields more than green-forage production. Varieties slow in stem elongation, such as Cooba and Algerian, are well protected from grazing injury.

WEED INVESTIGATIONS

Wimmera Ryegrass (*Lolium rigidum*)

Applied pre-emergence and incorporated: triallate, 16 oz a.i., 2-methoxy-4-ethylamino-6-sec. butylamino-s-triazine (GC14254) 1 and 2 lb a.i., 2-methylthio 4-ethylamino-6-tert. butylamino-s-triazine (GS14260), 1 and 2 lb a.i., siduron 2 lb a.i. and dichlobenil at $\frac{1}{2}$, 1 and 2 lb a.i. gave satisfactory control of Wimmera ryegrass and *Vulpia bromoides*. Unsatisfactory were linuron 1 lb, sidone 1 lb pre-emergence and GS14254 and GS14260 1 lb post-emergence at the 3-leaf stage. Incorporation of pre-emergent treatments improved their effectiveness against the weeds but with both the triazines at 1 and 2 lb a.i. and with dichlobenil at 2 lb, incorporation reduced yields as compared with not-incorporated.

Soursob (*Oxalis pes-caprae*)

Atrazine 2 lb, diuron 2 lb, linuron 2 lb, metobromuron 2 lb a.i. and picloram 8 oz a.e. per acre applied at the bulb exhaustion stage (May-June) significantly reduced weed-populations in the subsequent cropping-season. Maximum reduction in weed numbers, however, was obtained by deep cultivation at bulb-exhaustion followed by a second cultivation 6-8 weeks later and sowing a summer fodder-crop.

Skeleton weed (Chondrilla juncea)

The response of this plant to pasture competition varies with management practices. Application of 1 cwt superphosphate, as compared to no fertilizer, reduced weed-population. Increasing the application rate to 3 cwt/acre gave no additional response. Increasing the grazing-pressure from 2 to 6 sheep per acre tended to increase weed-numbers. The data suggests, however, that this may be due rather to pasture-composition changes than to stocking-rate. Rotational grazing and deferring grazing in the spring period, as compared with continuous grazing, increased weed-population significantly.

For post-emergence control of skeleton weed in the crop, picloram and picloram/2,4-D mixtures were applied (all combinations of 0, 0.1, 0.2, and 0.4 oz a.e. picloram with 0, 2, 4, and 8 oz a.e. 2,4-D). All except picloram 0.1 oz and 2,4-D 2 oz per acre, gave adequate weed control. Increasing the picloram content of the mixtures from 0.1 to 0.4 oz per acre tended to reduce grain-yields slightly, especially when used with 2,4-D at 8 oz. a.e. per acre.

Pre-emergence application and incorporation of trichloroetonitrile 2 lb a.i., dichlobenil 1 and 2 lb a.i. and the indane sindone 1 lb a.i. per acre tended to suppress skeleton-weed growth significantly and increased grain-yield.

PASTURE INVESTIGATIONS

Stocking Rates

A stocking rate (2, 4, and 6 dry sheep per acre) per superphosphate rate (0, 1, 2, 3 cwt per acre per annum) trial, commenced in 1962 on moderately low fertility land, has been continued. There have been some rather surprising results. The average greasy-fleece weights (4 shearings) for the rate of 2 sheep per acre was 10.5 lb. per head; for the rate of 4 sheep per acre, 9.5 lb per head; for the rate of 6 sheep per acre, 8.5 lb per head.

Top-dressing rates had a negligible effect on wool production in spite of the fact that only 636 lb of superphosphate to the acre had been applied before the trial started. The residual effect of this superphosphate was marked and it is probable that, with topdressing, some treatments will have reached "phosphate saturation" levels.

The results suggest that on this soil type, after 6-7 cwt of superphosphate has been applied, superphosphate could be more efficiently used by applying it to the crop and allowing the pasture phase in the rotation to function on the residual phosphate.

A sulphur deficiency became apparent on pasture which had not been topdressed. It indicated the need to apply sulphur in some form if low-sulphur fertilizers come into common use.

Finance has been provided to enable trials similar to the above to be established at other sites in the southern wheat belt.

Lamb Production

A trial has been set up to examine the monetary-returns effect of lambing in spring compared with early lambing. The trial is also to evaluate the effects of management systems involving autumn deferment, spring hay-cutting, and the production of special pastures for increasing lamb-growth rates. Lucerne is to be used to meet summer green-feed deficiencies, and oats will be used for mid-winter fodder. Effects of systems will be measured by wool growth and lamb production.

A mating was attempted in March but, because of the very poor season and the ewes immaturity, very few were joined. Another mating will be attempted in the spring.

Winter Fodder

A trial is proceeding to compare winter fodder-production from oats and from barley at high seeding-rates and an undisturbed wimmera ryegrass-subclover sward. The production-effect of 20 and 40 lb of nitrogen as sulphate of ammonia is included. In the poor seasonal conditions the trial could not be sown until 2nd June and there has been very little growth. Production will be compared by quadrat cutting.

Dry-land Lucerne

A trial to examine lucerne under intensive management was started in December, 1966. Merino breeding-ewes, autumn-joined, are stocked at 4 and 6 per acre. In a 9-paddock and a 3-paddock system lucerne is grazed for its growing period from spring to autumn. After the autumn break, when annual grasses make the greatest contribution, there are no treatment-differences. This is because annuals might be affected by the management systems and confound the effects of management systems on lucerne production.

Measurements are made of body weights, wool growth, lamb-growth rates, and teeth wear; and these are related to pasture production and botanical composition. Density changes are also noted. The results will help to assess the potential of lucerne as a dry-land pasture in the southern Riverina.

PLANT PHYSIOLOGY

Study of Water-use Efficiencies of Wheat Varieties

The plant physiology work this year has been concerned with determining the relative water-use efficiencies of the wheat varieties Heron, Mexico 120, Sunset, Hard Federation, Bencubbin and Winter Minflor. These varieties were selected as representing a wide range in both development and form.

Data from a complete climatic-cycle of one year have now been collected and are being assessed.

The study of water-use efficiencies is an aspect of the drought-resistance investigations at the Research Institute. For the coming year, the start of work on another aspect is proposed; namely, the measurement of drought-endurance in a range of wheat varieties.

PLANT PATHOLOGY

Wheat Bunt (Tilletia foetida)

Evaluation of Promising Chemicals. This work was prompted by the appearance in Australia of a race of bunt resistant to hexachlorobenzene. Several materials were found worthy of further testing. Also, differences between races with respect to reactions to certain fungicides have been found.

Eight seed-dressing products based on mercury were tested. All but one (based on methoxyethyl mercury silicate) were effective.

Systemic Fungicides Relative to Cereal Smuts

In preliminary tests an oxathiin derivative (vitavax), claimed to be highly effective in systemic action on all cereal smuts, was found to be very effective for barley smuts, but it was disappointing for loose smut of wheat.

Septoria Leaf-blight Epidemic

A severe epidemic of *Septoria tritici* developed in the wheat-breeding plots at both Wagga and Temora. Compared with early-sown, the late-sown plots of the same varieties were much less damaged.

Spotch Disease of Wheat (cause unknown)

Observations in Australia and overseas have revealed a very common virus-like leaf-mottling. It is most apparent at time of ear-emergence. Severity of the symptoms varies considerably, and whether the various grades of severity are of similar origin is difficult to determine.

The condition is passed on to all the progeny of the diseased plant. For this and other reasons, it seems unlikely that a virus is the causal agent.

The condition frequently comes to characterize particular varieties, although in Spica a commercial line was found to contain both healthy and diseased plants.

The disease resembles "spotch" found in durum wheats overseas, but its relationship to other virus-like conditions remains obscure. Co-operative work with the CSIRO is proceeding.

AGRONOMIC SURVEY UNIT

Critical Nitrogen-levels Survey

This survey programme aims to assess two critical levels of soil nitrogen below and above which wheat crops will and will not respond to nitrogenous fertilizers.

During the first half of 1967, 283 simple experiments were located within commercial wheat crops representative of the southern wheat-belt. Three nitrogen fertilizer levels (0, 30, and 50 lb of nitrogen per acre) were achieved by broadcasting ammonium nitrate at an early stage of crop development.

Comprehensive laboratory analysis of the soil samples taken (to 12 inches) before sowing from all these sites is being undertaken. The information will be coupled with details of paddock history, management, and climatic factors, to indicate when and where nitrogen fertilizers are likely to be worth while.

Weed Surveys

A second programme initiated during 1966-67 has been designed to clarify the relations between wheat yields and weed types/densities in the Southern Region. From this, determination of the weed levels at which control is economically justifiable should be possible.

Hand-weeding is being used to enable comparisons of yields under weedy and weed-free conditions. Already, weed populations six times as dense as the crop have been encountered.

Farm Wheat-yields Survey

Some years ago, the remarkable range in the levels of wheat production per acre on individual farms was observed. This prompted closer study of basic information provided in coded form by the Commonwealth Bureau of Census and Statistics.

It was established that very few farms in the Shire had consistently very low or very high yields over the period 1963-64 to 1965-66. However, it was shown that 19 per cent of the farms had below-average yields in each of the three years and 22 per cent of them had above-average yields in each of the three years. Over this period, the below-average farms yielded less than 60 per cent of the yield per acre on the above-average farms.

An attempt to compare farms in the two groups, to determine the reasons for such spectacular differences, was an obvious need. Soil types, soil fertility, management practices and emphasis, cultural techniques, and seasonal conditions would all have to be considered.

The Bureau of Census and Statistics agreed to contact farmers in the two groups, seeking their co-operation. However, the Bureau could not reveal the identity of the farmers willing to co-operate—unless assured that the research worker involved would not divulge to the farmers the farm-classification techniques used. This would amount to banning publication of basic aspects of the investigation.

Whether to proceed with the work under these conditions or to attempt an independent, time-consuming classification of all farms in the Shire has yet to be decided.

SOIL-TESTING PILOT SCHEME

The third and final year's field work ended with the 1966 harvest trials. Seasonal conditions were unusually good and grain yields were high. Unfortunately, the stripper's limitations prevented satisfactory harvest of thirteen trials wherein lodging was severe.

With respect to grain yield, there were significant positive responses to phosphorus in thirteen trials, a negative response in two trials, and no significant response in two.

Grain-yield increase, soil-phosphorus value, and applied-fertilizer rates were examined by multiple-regression analysis; for the 1966 season and for the whole three-year period. The results indicated that four of the analytical methods examined would provide a more reliable basis for recommendations than would the current method.

Examination of yield data in terms of profitability showed that at no rate of phosphate were profits surpassed when nitrogen was used. The regional recommendation of 100 lb superphosphate per acre was, on average, found to be the most profitable, but there was evidence for adjusting this rate; namely, less for drier areas and more for wetter areas.

As to the accuracy of existing soil tests: in 1964 and 1965 more profit was made by following the regional recommendation, while in 1966 the soil test advice was marginally superior.

FERTILIZER-AGRONOMY TRIALS

The following trials have been established this season:

(a) Six 5 x 2 factorial using 22 per cent superphosphate at 0, 50, 100, 200, and 400 lb/acre with sulphate of ammonia at 0 and 40 lb N; for continuous calibration of soil test analysis.

(b) Six 5 x 3 factorial using 22 per cent superphosphate at 0, 100, and 200 lb/acre and urea at 0, 20, 30, 40, and 60 lb N per acre; field trials in connection with soil-nitrogen test investigations.

(c) Methods of application of nitrogen using urea and sulphate of ammonia drilled with seed, topdressed and harrowed at seeding time and broadcast at 4-5 leaf stage.

(d) Method of application of phosphate using 22 per cent superphosphate and 12:52:0, drilled with seed, 2 in below seed and half with-half below seed, at three rates equivalent

to 0, 180, 240, and 300 lb 22 per cent superphosphate per acre. This trial is to test the effect of placement, and to investigate possible germination inhibition by the mixture 12:52:0.

(e) Comparative evaluation of 22 per cent superphosphate, 44 per cent concentrated superphosphate and the mixtures 12:52:0 and 18:18:0; sown with seed at three rates, with and without nitrogen, to balance the level applied in the mixture 18:18:0.

SOIL CHEMISTRY

Soil Phosphate

Soil Sampling. Sampling continued to receive attention. Sampling to 4 in was found to be necessary to assure an adequate reduction of the error-variance for phosphorus and pH analyses. This sampling-depth closely approximates the 0-10 cm recommended by the International Soil Science Society as a standard.

Particle-size of Standard Superphosphate. This varies widely from year to year and sometimes from batch to batch. To find the ideal size, four were compared. These were: Coarse, retained on a 4-in sieve; Medium, passing a 3/16 in sieve; passing a 1 mm sieve; and ordinary superphosphate.

Each size was applied, in the usual way, with the wheat seed at sowing through a combine drill. Both the coarse and medium grades were inferior to the other two in increasing grain-yield. The standard superphosphate brought about the largest yield-increase but this was not shown to be significantly greater than the effect of the fine grade.

Phosphate-fertilizer Comparisons. An experiment comparing the four phosphate fertilizers—basic slag, Nauru rock phosphate, calcined Christmas Island C grade phosphate and monocalcium phosphate—was reported in 1964-65. Soil analysis has now shown that the better residual-value of basic slag is due to the greater solubility of the fertilizer particles remaining in the soil, and not to a greater solubility of products of fertilizer-soil reaction.

It is not suggested that basic slag is likely to become an economic source of phosphorus in Australia but it is a type ideal for pastures on acid soils.

Maintenance Stage of Pasture Topdressing. Many farmers who have topdressed pastures over a number of years wish to know when their application rates can be reduced; in effect, when will they move out of the establishment-phase into the maintenance-phase.

In an attempt to answer this question, twenty-four soils from New South Wales here have been studied using the absorption isotherm technique. This enables calculation of the amount of phosphate that a soil will fix and also the energy with which the phosphate is held.

Results show wide differences between soils. Some are near capacity, whilst for others the possibility of economically reaching saturation is remote. Methods of solubilizing existing soil-phosphate or reducing fixation on such soils are being investigated.

Soil Nitrogen and Wheat Yield

Chemical and Biological Methods of Soil-N Estimation, Screened. The laboratory and field work in preliminary screening of a number of chemical and biological methods to estimate available soil-nitrogen have been completed.

Under greenhouse conditions the following relations were found between the various soil-tests and the dry-matter yield and plant nitrogen-uptake of ryegrass (harvested three times):

- (1) The concentration of nitrate nitrogen in the soil at planting, or incubation nitrate content, gave comparatively poor correlations. And these decrease with successive harvests. Inclusion of ammonia-nitrogen with the nitrate-nitrogen gave a superior correlation with the initial harvest. But this also decreased with successive harvests.
- (2) Chemical methods which determine the mineral nitrogen and part of the amino-acid fraction all showed improved correlations with successive harvests. The stronger the acid or the more vigorous the digestion treatment, the better the correlations obtained.
- (3) Inclusion of total mineral nitrogen concentration with the various soil tests, in a multiple correlation, results in some improvement with those tests which normally only determine the organic-nitrogen content of the soil.

Under field conditions the best correlations between total dry-matter at flowering and grain-yield at harvest were obtained by acid hydrolysis/digestion methods. Inclusion of nitrate nitrogen content in the surface soil (0-4 in) and also from the subsoil (8-12 in), in a series of multiple regression models resulted in some improvement in the correlations.

Despite the strong influence of climatic conditions in determining crop responses to soil and fertilizer nitrogen in the southern New South Wales wheat belt, these preliminary studies have indicated need for further investigations. Some of the more promising nitrogen soil-tests have been selected for further study in a series of field experiments.

Fallowing and Wheat Production

Following on results at Wagga in a study of the effectiveness of length of fallow preparation, in terms of moisture conservation, mineral-nitrogen availability, and weed control (see 1964-65 Annual Report, page 103), four trial sites were established in August, 1966, in the 16-26 in rainfall area.

A period of ten months fallow resulted in no additional conservation of soil moisture, compared with the grazed pasture treatment. Long fallowing, however, gave the expected increase in concentration of available mineral-nitrogen at sowing.

Nitrogen Fixation Studies

Investigations were started in 1965 into possible effect of wheat seed inoculated with free-living nitrogen-fixing organisms such as *Azotobacter* spp. The work was continued in 1966. As recorded in the 1965-66 Annual Report there was no response by wheat inoculated with *Azotobacter* spp. sown on high-fertility soils. Time of sowing had no influence on the responses to the inoculation, either in final grain-yield or the rate of development of the crop during the growing season.

Nitrogen Fertilizers and Wheat

Study of the suitability of various forms of nitrogenous fertilizers for wheat production in the Wagga area continued in 1966. The results were similar to those reported last year. Use of nitrogenous fertilizers on the first crop after a period of clover ley depressed grain-yield from 42 bushels to 32 bushels per acre.

Various methods of nitrogen-fertilizer application (broadcasting, predrilling, drilling with seed) are now being compared. The drilling of some nitrogenous fertilizers (e.g. urea) resulted in poor seed germination, even at low rates of application, under the low soil-moisture conditions in the autumn of 1967.

Agricultural Research Station, Tamworth

GENERAL

A very favourable spring season allowed field work in all of this Research Station's programmes to return to normal after the severe drought of the previous year. In many areas there were record crop-yields, and experimental treatments were tested under high-production conditions.

Establishment of a major trial to evaluate the productivity of grazing-lucerne provided a high spot in the year's activities. This was made possible by increases in staff in the areas of pasture and animal production, and indicates a desirable trend in the activities of the Station.

The Station's work is now less heavily biased to the major crop—wheat. Appointments for plant pathology and agronomy of summer crops have also helped very much to broaden the scope of research undertaken and provide better coverage of the area's problems.

Pasture Research

The pasture research programme has involved selection of legume and grass species for the wheat-growing areas. Particular emphasis has been given also to studies of effectiveness and ecology of root nodule bacteria, and their contribution to nitrogen fixation in both the wheat-growing and the adjacent low-fertility granitic pastoral-areas of New England. The latter studies are supported by funds from the Australian Meat Research Committee.

Evaluation of Pasture Species

Grazing Trial on Lucerne. Evaluation of lucerne under a range of stocking rates (3.3 to 8.7 dry ewes per acre) started in November, 1966. Estimates of the feed consumed by sheep

(determined by cages in conjunction with an electronic pasture meter) exceeded yields measured by cutting permanent enclosures at intervals (governed by normal plot-cutting considerations).

It is evident that lucerne production has been totally dependent on incident rainfall, rather than stored subsoil moisture. Thus, production has dropped sharply during periods of low-incident rainfall. Fluctuations in liveweight and estimates of lucerne production have shown good correlation, and indicated that the methods used to measure production are reliable.

Preliminary examinations have demonstrated a decrease in plant density at the highest stocking rate (8.7 dry sheep/acre). A number of factors have contributed to this decline. The major factor is damage to lucerne plants during periods of feed shortage, when the sheep dig the soil from around the crown of the plants and then severely graze the exposed crowns.

The trial sheep were not mated this year. They will be mated in 1968 for late spring lambing.

Plot Testing of Lucerne Varieties. Yield tests were continued with lucerne varieties under different inoculation treatments, at Tamworth and Bendemeer.

At Tamworth, previous indications of high yield by African and Canberra Hay varieties were confirmed; while, contrary to results from other areas, plant density of African has not dropped appreciably more than the other varieties since the plots were established in 1964. These plots will now be set-stocked to determine relative persistence of creeping and upright varieties.

The Bendemeer plots have indicated an apparent change in effectiveness of fixation by a commercially used *Rhizobium* strain. The results are being prepared for publication. Further plots of lucerne and crown vetch varieties were established in 1967 in the granitic area.

Plot Testing of Temperate Grasses. Plots of commercially available temperate grasses, sown in 1966, are being heavily grazed at regular monthly intervals to examine persistence. Yield data are also being collected. Annual ryegrass so far has been superior in yield, but persistence of Italian ryegrass has been badly affected. Phalaris and prairie grass have yielded well and a range of new phalaris varieties for yield testing was established in 1967.

Practices Affecting Clover Growth and Rhizobium Survival

This experiment is concerned with effect of cultural, nutrient, and inoculation practices on clover growth and rhizobium survival. It was established on granitic soil at Bendemeer in 1965 and has been extended to allow further sampling under more normal rainfall conditions.

Lack of cultivation and of elements other than phosphorus and sulphur have affected legume persistence but rhizobia have survived well under all conditions, suggesting that absence of root nodule bacteria is not necessarily a causal factor in loss of legumes from these pastures once they have been established.

Field Measuring the Contribution by Naturalized Rhizobia

Temperate Legumes in the Presence of Grass. Plots established at Bendemeer in 1966 with 10 legumes have been sampled at frequent intervals to determine (i) total nitrogen fixation by legumes and (ii) the time of nitrogen release in a mixed pasture situation where soil nitrogen levels are very low.

It is clear that grass production and persistence have been greatly affected by the type and maturity date of the associated legume. Rapid release of nitrogen by annual legumes has certainly been found to benefit associated grasses, and a range of seasonal patterns is evident with different legumes. Pure grass controls receive a range of nitrogen treatments.

Legumes in Pure Stands. Short term studies of responses by legumes to inoculation and nitrogen treatment have been carried out with cowpeas. The studies will be continued annually with cowpeas and lucerne.

In the trials so far it has been evident that while nodulation response may be obtained with inoculation, under some conditions the fallow which precedes growth of some annual crops can provide enough nitrogen to prevent significant nitrogen input from the legume.

Evaluation of Naturalized Root-Nodule Bacteria

The fixation potential of rhizobia can be simply measured under controlled growth conditions in the laboratory. Results so far suggest that naturalized rhizobia in the cropping region

are reasonably effective in lucerne. The continually expanded area being covered, with associated field trials, should provide in the future a useful basis for recommendations for inoculation.

PLANT PATHOLOGY

Survey for Plant Disease Investigations

The main crops in the northwest were surveyed with a view to defining those problems requiring further investigations. As a result of the survey, research on the following plant disease problems was initiated:

Wheat Crown-rot. This disease, caused by *Fusarium roseum* "graminearum", is endemic in the northwest and may cause severe losses in some years. Research is necessary (a) to define the method of survival in the field, and (b) to investigate possible resistance sources.

It is generally considered that in the absence of suitable hosts the fungus exists as a saprophyte in decaying wheat stubble. Investigations at Tamworth indicate that the fungus may also exist as chlamydospores, a method of survival not previously recognized for this fungus.

Other workers have unsuccessfully searched for possible sources of resistance to this fungus. But Canadians have had encouraging results looking for resistance to *Helminthosporium*, another organism involved in foot and crown rot of wheat. Therefore it could be profitable to look again for resistance to *Fusarium*, using methods that will truly reflect resistance rather than susceptibility.

Cotton Verticillium Wilt. Incidence and distribution of *Verticillium* wilt in cotton crops of the Namoi were surveyed. High incidence of wilt in crops on old farming land was attributed to pathogen increase on broad-leaved weeds in the area.

It was suggested that land cultivation for growing grain crops is accompanied by introduction of a bigger and more varied range of broad-leaved weeds whereon *Verticillium* may persist and increase. It was predicted also that if cotton is grown in a monoculture the level of soil-borne inoculum will increase further. This in turn will increase the likelihood of severe economic losses to the disease.

As the wilt incidence increases, cotton growers will have to rotate crops on their land. Thus, the question is what crops can be grown to reduce the level of *Verticillium* in the soil.

Virus Disease of Maize. A virus disease thought to be the Johnston Grass strain of sugar cane mosaic virus is widespread in maize in the Tamworth and Grafton districts. It has been observed on maize, Johnston Grass, and *Sorghum alnum*. Just what damage the disease is causing here is not yet known but in the U.S.A. the disease is serious. The plant pathologist is co-operating with Division of Plant Industry maize breeders, and with plant pathologists in Division of Science Services, to find sources of resistance to the virus. Field observations indicate resistance in some maize varieties.

WHEAT IMPROVEMENT WORK

Hybrid Wheat

The Station's Wheat Breeder Mr B. C. Imrie left for overseas post-graduate studies in September, 1966, but supervision of the hybrid programme has been undertaken by another officer.

Crossings. These were continued, to transfer male sterility and fertility restoring factors to as wide a range of varieties as possible. The most advanced sterile lines now have four to five doses of the recurrent parent while the restorer lines are a little behind this.

Mendos, Gabo, Gamut, Festiguay, Glenwari, and Funello have been made sterile and fertility restoring factors have been incorporated into similar lines.

This crossing will continue for the next two or three years with emphasis on restorer lines.

Seed production. This is a vital part of any hybrid programme, with percentage seed-set on male-sterile plants an important economic factor in seed production. Seed-set on cytoplasmic male-sterile plants which rely on wind-borne pollen is determined by morphology of the flower, receptivity of the stigma, the availability of pollen during the receptive period, and the pollen viability.

This aspect of hybrid wheat production has been under field investigation this year. The seed-set on male-sterile Gamut and 8704 sown among a commercial sowing of Gamut is being studied. Humidity and pollen availability when the steriles are flowering are being related to seed-set on the sterile lines.

The economics of hybrid-seed production largely depends on the extent that hybrid vigour is expressed. To examine the expected increase in yield due to heterosis, a large number of varieties with wide genetic-diversity have been sown; so that in the 1967 spring a large number of crosses can be made by hand to produce seed to determine the extent of hybrid vigour.

Durum Wheats

New Semi-Dwarf Selections. The durum programme has reached a very interesting stage. This season seven advanced semi-dwarf lines are undergoing extensive yield and quality tests. Last year's preliminary yield trials have indicated that the seven are substantially better yielders than Dural, and have at least the same quality—with a possible increase in yellow pigment. If that performance is maintained in this season's trials a new variety will be available for release a year hence.

About 200 lines just one stage behind the more advanced lines are currently being evaluated, and many of them are showing extreme promise.

World Durum Variety Collection. In the introduced U.S.D.A. world durum collection, 2,000 of the 3,000 varieties are being grown in the field this year. They will be intensively observed from emergence to harvest, and screened for characters of use in breeding. These will be incorporated into the crossing programme this season, broadening the genetic base of the durum material.

Demand for Durum Wheat. Discussions were held with several trade representatives in 1966. Increasing interest in durum products was apparent, particularly in high-quality semolina produced from Dural. Increased demand seems likely.

Bread Wheat Breeding

Effect of the Season. Plots were sown in mid-June, after moderate rainfall. Subsoil moisture was generally lacking after the drought. Establishment was moderate and initial growth was slow. Weed growth was a problem at some sites. By August, conditions had deteriorated badly. Moisture in the top horizons of soil had been exhausted and secondary rooting had not been initiated. At this stage, prospects looked bad. Many areas in the Northern Wheat Belt had reverted to drought conditions. Spring rains saved the crops, and regularly light to moderate falls combined with mild temperatures led to a record crop and record per-acre yields.

Of interest, many high-yielding crops had no or little secondary-root development. This helped to cause the grain's low bushel-weights in some areas.

Harvest was late in starting, because of absence of high temperatures. Rain caused damage and delay only in isolated areas.

Winter Wheats. Absence of February rains prevented sowing of winter wheats until May-June. Therefore, no grazing-yield data were available.

An attempt is being made to produce a developmental type different to the earlier wheats released from this programme. The aims are at April sowing, high early production of feed, termination of grazing in mid-July, with accent on grain production. Alternate-type "winterness" has been used in this material, and some data are available on grain yield and quality as well as disease resistance.

Such types could contribute usefully to the feed-year on mixed areas and would complement the classical-type, long-season winter wheats.

Spring Wheats. Selections of the line 8704, made by Dr H. Luig at the University of Sydney, for improved rust resistance, were increased and given preliminary field testing. Agonomically, these selections were attractive, although preliminary quality tests were disappointing. Physical dough tests suggest the selections were about one-third to one-half of the strength of the unselected bulk.

Similarly, reselection for improved resistance to stem rust in the lines 8127 and 8128 was undertaken in co-operation with Dr Luig. These selections were increased over the summer and re-examined in the field for both yield and quality. Both 8127 and 8128 showed promising overall performance in ten replicated yield trials at centres throughout the north-west. There appears to be good possibility of selecting a variety from this pedigree. They are of the breeding Warigo x Kpng x Mexico x Uruguay.

Semi-dwarf. A large population of semi-dwarf material was screened for disease resistance and quality. The majority of lines were low in quality, but about 10 per cent were of sufficient merit to promote to field trials in the 1967 season.

CEREAL CHEMISTRY

Wheat-quality Tests

Routine testing of all new bread-wheat varieties has now been established.

Promising New Varieties Tested. Some promising new varieties have appeared recently in the wheat-breeding programme and been tested. Varieties 8127 and 8128, two of the best, have been baked over a wide range of protein content (from 6.5 to 17.4 per cent) and the loaf-scores have ranged from 73 (out of a maximum of 80), to 0 with some of the very low-protein flours. There was marked falling-off of baking quality with protein contents under 12.0 per cent. Their baking characteristics at high protein levels compared very favourably with Mendos, Festiguay, Spica, Gamut, and TR 135 at similar protein levels. Both 8127 and 8128 have very satisfactory disease resistance patterns.

At least six other crossbreds show considerable promise, as judged by the baking test. Moreover, a modified "remix" test is in use. This imposes fairly drastic conditions during baking. The test is thought appropriate in view of the increasing trend towards high-speed mechanical development of doughs in modern bakeries.

Winter Wheats Quality Tested. A large batch of winter wheats were subjected to quality testing for the first time. Pelshenke tests were performed, and the wheats were milled and baked. The quality of many of these wheats was established by these tests as remarkably high, although the wheat breeder had to do most of his selection on agronomic characters.

Hybrid Wheats Quality Tested. A small batch of hybrid wheats were tested. Unfortunately, only small weights of seed were available. The testing was therefore restricted to the Pelshenke test and analysis for protein and moisture content.

Wheat from Fertilizer Trials. A large quantity of wheat material was obtained from fertilizer trials, all of it Mendos, grown under widely diverse soil and climatic conditions. The cropping histories and fertilizer treatments of the sites also differed.

Results from this material have only recently been collated. Preliminary inspection of the data has revealed marked responses to certain treatments at given sites.

PLANT NUTRITION

Sulphur/Phosphorus Nutrition of Lucerne

Two glasshouse experiments were carried out to determine the effects of applied phosphorus and sulphur on the dry-matter yields of lucerne grown in eighteen different soils. A second aim of the experiments was to determine critical levels of phosphorus and sulphur in the above-ground portion of the lucerne plant. The lucerne in each experiment was harvested at the start of flowering, on three successive occasions.

Sulphur. At the first harvest, five of the eighteen soils gave significant responses to sulphur. On two of these soils the responses were significant only in the presence of phosphorus. At the second harvest, another six soils gave responses to sulphur. By the third harvest only one soil failed to show response to sulphur.

Sulphur concentration of the lucerne tops varied, from 0.268 per cent dry matter in the least deficient soil (dark-brown Pilliga sand) down to 0.065 per cent in the most deficient soil (Willow Tree black earth). Lucerne containing more than 0.14 per cent sulphur failed to respond to applied sulphur in every case, whereas, in 93 per cent of cases, lucerne containing less than 0.10 per cent sulphur did give significant responses in dry-matter yield. Lucerne containing sulphur between these two levels responded in 36 per cent of cases.

The results indicate that the sulphur concentration of lucerne tops at early flowering does reliably indicate the sulphur status of this species.

In every soil the level of tissue sulphur increased dramatically after the first harvest. Wherever the initial level of tissue sulphur was below 0.15 per cent the plants were sulphur deficient (i.e., contained less than 0.10 per cent) at the second harvest. However, in at least one-third of the soils this reduction was a dilution effect caused by a greatly increased yield at the second harvest. In these cases the uptake of sulphur actually increased following the first harvest. With one exception, there was a general reduction in sulphur uptake at third harvest—regardless of whether dry-matter yield increased or decreased.

Phosphorus. Two-thirds of the soils responded significantly to phosphorus, and the responses were generally maintained throughout the experiment. Due to increasing sulphur deficiency, phosphorus responses at third harvest occurred only in the presence of sulphur.

Phosphorus-concentration of lucerne tops varied from 0.22 per cent dry-matter in a Breeza chocolate soil down to 0.054 per cent in a Winton Black earth. Lucerne containing 0.18 phosphorus, or more, failed to respond to applied phosphorus, whereas in 83 per cent of cases, lucerne containing less than 0.13 per cent phosphorus did respond significantly in dry-matter yield. Lucerne containing intermediate levels of phosphorus responded in 50 per cent of cases.

Thus the critical levels of tissue phosphorus do not appear to be as clear cut as those for sulphur.

There was little difference in the phosphorus concentration of the lucerne tops from the beginning to the end of the experiments. Any decreases were due to dilution rather than a reduction in the supply of available phosphorus.

Sulphur/Phosphorus Nutrition of White Clover

Each of the three field experiments sown in the Bende-meer-Kingstown area was well established, and was harvested four times during the five months November to March. Each site was extremely deficient in phosphorus and moderately deficient in sulphur. Highly significant responses to phosphorus occurred at every harvest, but responses to sulphur were not so consistent.

Sulphur. Yield responses to sulphur levelled off at 25 lb/acre. Glenby appeared to be the most deficient in sulphur, although responses were not significant at the second and third harvests. Responses faded out at all sites at third harvest but reappeared at fourth harvest in late March. Applied sulphur did not appear to have any consistent effect on the nitrogen content of the white clover tops.

Phosphorus. Yield responses to phosphorus reached a maximum at rates of 100–200 lb P_2O_5 /acre. In the absence of applied phosphorus, growth of white clover was negligible whereas maximum yields reached 1,600–2,200 lb dry matter/acre with phosphorus. The optimum rate of applied P_2O_5 varied from 100 to 150 lb/acre at Tilmunda and Kiaora, whereas, at Glenby, significant increases in yield continued up to the maximum rate of 200 lb/acre.

Phosphorus levels of the white clover tops varied somewhat, from one harvest to another, but optimum dry-matter yields were obtained at levels exceeding 0.20 per cent. In absence of applied phosphorus, levels were generally around 0.10 per cent.

The results indicate that the granite soils require at least 4 cwt/acre superphosphate to supply the phosphorus needs of white clover in its year of establishment. This rate will supply more than sufficient sulphur.

Sulphur Nutrition of Wheat

A glasshouse experiment was carried out to determine the effects of applied sulphur and phosphorus on the dry-matter yields, nutrient concentrations, and nutrient-uptake of wheat grown on three sulphur-deficient soils. Two of the soils were also deficient in phosphorus. The wheat (Windebri) was cut three times to study the rate of development of sulphur deficiency, in comparison with that of lucerne.

Sulphur. Sulphur deficiency developed almost as quickly as it did in lucerne. At the second cut, two soils were showing a significant response to sulphur, and at maturity (3rd harvest) all soils were showing highly significant responses to sulphur—in both straw and grain yields. These responses occurred with and without applied phosphorus, but on the two phosphorus-deficient soils the responses with phosphorus were much greater than those without.

The sulphur concentration of the straw appeared to be little affected by maturation, being very high (0.20) in the sulphur treatments and very low (0.08) in the no-sulphur treatments. Sulphur concentration in the grain were more normal; varying from 0.12 per cent to 0.17 per cent in the sulphur treatments and less than 0.10 per cent in the no-sulphur treatments. Sulphur deficiency appeared to limit the translocation of nitrogen from the straw to the grain, as excessively high levels of nitrogen (2.6 per cent) remained in the straw at harvest, and the nitrogen/sulphur ratios in the grain in the sulphur treatments were less than 17 in most cases. The lower levels of grain nitrogen in the very high-yielding phosphorus/sulphur treatments would suggest that nitrogen may have been slightly limiting in these treatments.

The yields of dry matter and tissue levels of sulphur in the wheat during the period of the experiment indicated that total sulphur-uptake by the wheat on these soils was quite comparable with that of lucerne.

Phosphorus. The two phosphorus-deficient soils gave highly significant responses to phosphorus initially. But these responses disappeared at the second harvest due to limitation by sulphur deficiency. At maturity, responses to phosphorus in straw and grain yield were only in the presence of sulphur.

Phosphorus concentration in the tissue was depressed by applied sulphur and increased by applied phosphorus. This effect increased as sulphur became more limiting, due to luxury consumption in the no-sulphur treatments and dilution in the sulphur treatments. As with nitrogen and sulphur, phosphorus concentrations in the grain were more normal than in the straw tissue.

Legumes, and Wheat Soils Productivity

Glasshouse Experiment. This experiment determining nitrogen-fixation by lucerne on 10 different soils was completed. The amount of nitrogen fixed was estimated by comparing the nitrogen-uptake by wheat and lucerne grown simultaneously, and the nitrogen-uptake by wheat grown subsequently on the same series of soils.

The results indicated that during 6½ months of growth the lucerne fixed the equivalent of 190 to 590 lb nitrogen/acre. On seven of the ten soils, applied phosphorus and sulphur significantly increased nitrogen-fixation and subsequent nitrogen-transfer to wheat plants.

Field Experiments. The two major long-term experiments were well established, and normal yields of wheat and lucerne were obtained from the appropriate treatments. However, summer drought delayed the sowing of the cowpea treatments and yields were very small.

Two small but long-term field-experiments were established at Somerton and Werri Creek, on paddocks immediately following lucerne-leys. These experiments will measure changes in soil nitrogen and wild oat population following lucerne.

PLANT PHYSIOLOGY

Wheat Frost Injury

Variety Testing. Testing of introduced spring-habit varieties for resistance to ear- and stem-frosting continued. The settings in 1966 increased to more than 600 the total varieties so far examined.

Results suggest that, whereas it is relatively simple to progress from the high level of frost-susceptibility possessed by current commercial-strains to a moderate degree of resistance as shown by the Mexican selection IRN 101, it may be much harder to make another forward step of similar magnitude.

Amongst the early-flowering spring-wheats suited to the Australian environment, perhaps 2-3 per cent have this moderate degree of resistance and form a plateau indicating the upper performance-level readily available.

With this in mind, the emphasis of the routine-testing side of the programme has been changed to bring in a broader spectrum of material. In particular, the cold-hardy winter wheats, other wheat species, and even different genera, are being examined. This approach has been facilitated by the acquisition of a controlled-environment cabinet.

Factors Affecting Frost Injury. Use of controlled environment also facilitates more close control of nutrition and it has been found that sulphur, perhaps through its influence on nitrogen metabolism, has a profound effect on frost-hardiness. Further work is required in this field. Appropriately, support has been received from the Wheat Industry Research Council for studies on biochemical aspects of cold resistance.

Basic work on ice formation in tissues was continued in the United States of America, using electrophoretic techniques developed by Dr C. R. Olien. Results showed that mature stem-tissues may suffer severe and immediate damage through quite mild freezing, but that this may be very difficult to detect. Injury to immature tissues is readily seen, but may be physiologically much less serious.

These observations have significance in the understanding of ice-crystals location and the distribution of free water at the nodes; and therefore on the fate of the ears. The ears must remain unfrozen to survive.

Yield and Development of Wheat

Photoperiod and Temperature Studies. During 1966-67, data collected in the previous two years were compiled and some preliminary analyses undertaken. From these observations, rates of progress of twelve wheat varieties through successive developmental stages were related to photoperiod and temperature conditions measured in the field.

Response to vernalization was conditioned by time of sowing, and the relative earliness in ear-initiation of the variety.

The latter findings showed that extrapolation to the field situation, of data on vernalization-response obtained under controlled environmental conditions, is not possible without considering the relative earliness of the variety in the field. It was also revealed that to have adaptive-significance by delaying ear-initiation, the vernalization-response of varieties should be equal to or greater than that of Festiguay and Pinnacle; the vernalization-response of Gabo being too small.

When rates of development in the field were related to mean daily-photoperiods and mean daily-temperatures, by multiple correlation, success was achieved in accounting for between 60 per cent and 99 per cent of the variation in the duration of phases—depending on variety and phase. There were varietal differences between the simulation equations. Statistical analysis and interpretation have not yet been completed.

Responses to temperature, as measured under constant fifteen-hour photoperiod, showed that for all varieties and phases the rates of development were positively correlated with temperature. There were marked varietal-differences, in responses to temperature, of the pre-initiation and initiation to ear-peep phases. There were no such differences in the ear-peep to anthesis and post-anthesis phases.

Experimental work in 1966 concerned the examination of leaf number, as a measure of the timing of ear-initiation; and a closer study of response to vernalization under constant and relatively short day (fourteen hr). An obvious preliminary conclusion from this data was that leaf number should be used with caution as a measure of time of ear-initiation in the field. Considerable variation in this parameter was observed in plant material grown under uniform conditions. It highlighted the need to include large numbers of plants in testing leaf-number values to express responses to vernalization.

Wheat Crop Physiology and the Environment. This project complements a number of other physiological studies being conducted on cereals within the Department; on water-use efficiency, genetics of development, crop-growth analysis, rate of development, and frost injury.

The principles involved in yield determination of cereals have been fairly well established. This project aims to study quantitatively some of these relationships as they occur in the northwest wheat belt. It is essentially a long-term investigation.

The varieties Mendos, Festiguay and 8704 were sown in the field on 7th June, 29th June, 17th August, and 9th September. Crop-growth data showed that for the early variety, Mendos, grain-yield decreased as sowing was delayed. Grain-yield showed a positive association with the amount of crop dry-matter produced at flowering but little with other parameters such as head-number per unit area or spikelet-number per head. The later varieties, Festiguay and 8704, gave highest yields when sown in late June. Grain-yield of these two varieties could not be explained in terms of crop dry-matter production at flowering, or other yield-components. The three varieties assumed different rankings for yield, depending on sowing times.

DIVISION OF MARKETING AND AGRICULTURAL ECONOMICS

Scope

This Division conducts research into economic aspects of rural production and marketing and provides extension services in farm management and farm economics. It is responsible also for administration of the Marketing of Primary Products Act, 1927-1965, and in this connection provides a comprehensive market-reporting system, periodic crop-forecasts, and crop and pastoral reviews.

Economic Research

The more important research projects completed during or in progress at the end of the year were as follow.

ECONOMICS OF WHEAT STORAGE

A study of the capacity and costs of permanent wheat-storage facilities in New South Wales has been completed and published in the *Review of Marketing and Agricultural Economics*.

For the 1964-65 harvesting season the permanent bulk-wheat storage-capacity in New South Wales was estimated as 140 million bushels; 35.9 million as on-farm permanent storage, 70.3 million as local-silo storage, 16.5 million as sub-terminal storage, and 17.3 million as terminal storage.

Where feasible, weldmesh bins beneath existing sheds is the cheapest means of on-farm permanent storage. Otherwise steel silos are cheapest for up to 10,000 bushels of storage, and then grain-sheds.

Steel bulkheads were found to provide the cheapest, local-silo, sub-terminal and terminal storage.

Overall, local-silo storage was found to be the cheapest form of storage if units of 500,000 bushels or more could be utilized; if less than this capacity could be utilized, then terminal storage was the cheapest.

Measurable-average, real long-run annual costs per bushel on which the comparisons were based were: 11.89 cents for 1,000 bushels down to 3.65 cents for 20,000 bushels capacity of on-farm permanent storage; 3.68 cents for 100,000, 2.86 cents for 300,000, and 2.64 cents for 500,000 bushels of local-silo storage; 5.33 cents for sub-terminal storage, and 2.64 cents per bushel for terminal storage.

In continuance of this project a transportation model incorporating problems of variable wheat-production is proposed to determine where to construct additional wheat-storage capacity and how much.

POULTRY MANAGEMENT STUDY IN THE SYDNEY AREA

This study was completed and the detailed report is being processed, to be available shortly. It involved a detailed comparative analysis of a small sample of egg producers, to investigate the economic and physical basis of successful poultry farming and to establish comparative standards to aid extension work in poultry farm management. Daily records were maintained by the producers and forwarded monthly for analysis.

The aims were achieved and many findings were extracted. Yield per layer and labour per layer were two of the most significant factors influencing return to management per layer. A relationship of interest showed; the farms with the greatest amount of capital invested per layer earning the greatest return to capital. Other factors influencing profits were lighting practice, feed consumption, age at commencement of lay, age at culling, time of mortality, system of housing and breed of bird. Seasonality of production and the feeding of home-mixed or proprietary feeds appeared less significant than was anticipated. Size of enterprise was, as expected, the major factory influencing size of net farm-income.

BANANA DEMAND-STRUCTURE AND SUPPLY-CONTROL

A demand-function for bananas in Australia was derived to determine whether returns could be raised by restricting supplies. Unfortunately, the range of the quantity-coefficient in the function was too wide to provide a definitive answer. A brief report on the study was published in the *Review of Marketing and Agricultural Economics*.

ECONOMICS OF WHEAT SEGREGATION

The project should be complete by June, 1968. The aim is to assess whether segregation of New South Wales F.A.Q. wheat into hard and soft classes will significantly aid the merchandising. This hypothesis is being tested against a necessary condition, that segregation will increase consumer-satisfaction, and a sufficient condition that the gain to producers exceeds the opportunity-costs of such segregation.

It has been necessary to consider the theoretical aspects of grading, the structure and conduct of the wheat market, consumer-demand patterns for wheat products and the derived demand for wheat and wheat quality, and the costs of wheat segregation.

METHODOLOGICAL STUDIES IN DYNAMIC MODELS OF PRODUCTION

The theoretical basis of formulated economic models, using dynamic linear programming and dynamic programming, is being examined. This research is designed to throw light on the existing theory of the farm firm, but also to pave the way for improving the efficiency of farm management analysis—by providing better and more workable models. It is particularly relevant because of increasing use of linear and other forms of programming in farm management research work. The officer on this work is writing a book on the subject (*Introduction to Mathematical Programming*) to be published by Ramdon House, New York.

COMPUTER PROGRAMMING

Considerable work on computer programming was done, and a number of the research projects listed in this report are being completed with the aid of programmes written or modified by an officer of the Division who is specializing in it. Some details of the work, not referred to specifically elsewhere, follow:

- (a) Documentation of a programme (titled WHEAT) was completed and lodged with the Treasury Automatic Data Processing (A.D.P.) Centre. This programme was designed to analyse returns from a mail survey of 1,500 New South Wales wheat-growers. Staff of the University of Sydney Faculty of Agriculture have recently borrowed this programme and its documentation, and have expressed an intention to modify it for use in analysis of their own surveys.
- (b) A programme ALFCRD has been written to eliminate a large volume of clerical and supervisory work involved in transposing the data for linear programming problems amongst the differing formats required by the various programmes.
- (c) The linear programme RSMC for the Honeywell 800 computer has been modified, in collaboration with the Treasury A.D.P. Centre. This modification, to be known as AMERSHEM, has been tested initially and is about to undergo Systems Testing. It will be available for general use early in 1967-68. Its function is identical with that of the programme RSMC, but it can handle much larger problems.
- (d) Modification of a programme written by the United States Department of Agriculture for simulation of the operation of dairy farms has been commenced. This will be used, probably not until 1968-69, in a follow-up to the current study of metropolitan dairy farms.

LINEAR PROGRAMMING STUDIES

Apart from the several listed projects wherein specific reference is made to the linear programming technique, reference must be made to other current work in the field of linear programming.

Work referred to in earlier reports, on a linear programming study of farms in the Wagga district, has been continued. The project will not be completed for several years. The aim is to derive recommendations for use by farmers in the area east of Wagga in their farm planning programmes. The study relates in particular to optimum combinations of alternative enterprises. A number of subsidiary problems, including the extent of pasture improvement, and lambing times, are also being considered.

Some work has been done also on designing a linear programming system to assist in planning development of properties over a period of years. Other commitments have restricted the time available for this project and final results will be delayed. It has also been necessary to defer the linear programming study of Hunter River dairy farming, referred to in previous reports.

Most of the linear programming work has been carried out at the Treasury A.D.P. Centre, but it has been necessary to use commercial processing facilities available from the I.B.M. Service Centre for parametric linear programming—as this work cannot be handled at the Treasury A.D.P. Centre.

LINEAR PROGRAMMING STUDY, CLARENCE RIVER BASIN BEEF HOLDINGS

A linear programming study to help the allocation of research priorities at Grafton Agricultural Research Station has been commenced. The agricultural economist's role in the inter-disciplinary research venture now under way at the Station is seen as follows:

- (i) given the existing state of technical knowledge, to determine the optimum allocation of intra-farm resources;
- (ii) in the light of the existing physical and non-physical restrictions, to give direction to future research aimed at easing the most limiting restrictions on production;
- (iii) to determine the directions of change in resource combination, given developments in technical knowledge and changes in economic conditions.

Considerable progress has been made. The representative farm concept has been used, with data gathered in a 1965 economic survey in the area. The results will be published during the ensuing year.

REGIONAL ADJUSTMENT IN THE FAR NORTH COAST DAIRY INDUSTRY

This major study is being continued, but resignation of the senior officer concerned has necessitated a re-examination of the project. Arrangements are in hand to carry the work on from the point at which it had to be discontinued.

The economics of particular, technically feasible adjustments which a "typical" north coast dairy farmer may undertake to improve his income position have been assessed. The general direction which adjustments should take can be predicted, but the rate at which such adjustments can be expected to occur has yet to be assessed.

Work now to be done will attempt to assess factors influencing and, in particular restricting, farm adjustment in the area. Predictions of anticipated rates of adjustment will be attempted. Possible policy measures to facilitate the adjustment process should become apparent from this research.

OPTIMUM FEED-YEAR PROGRAMMES, NORTH COAST DAIRY FARMS

Because of the increasing range of tropical and temperate pasture and forage crop species for continuity of high-quality feed on north coast dairy farms, the development of a quantitative method to plan a dairy farm feed year is being attempted.

Initially a linear programming model has been used to determine for a hypothetical representative dairy farm on the red basaltic soils of the north coast the most profitable herd size, calving pattern, and combination of a range of alternative methods of meeting herd feed needs. The feed needs of the herd were determined using a regression equation developed by New Zealand workers, and pasture productivity was estimated from research data.

In developing the initial simplified model, the problems in determining herd feed needs and pasture productivity under different management systems have been highlighted. Further research is being done, to develop a more realistic model to take account of these factors. Parametric programming procedures will be used to investigate the effect of variations in matrix coefficient values on the optimum feed year plan.

FARM DEVELOPMENT PLANS, NORTH COAST DAIRY FARMS

A multi-stage or poly-period linear programming model, incorporating the feed year planning model, is being developed to determine optimum farm development programmes. The model will be used to examine such factors as:

- (i) the availability of capital, its influence on the rate of development and the lag between the time of initial investment and the time when total cash outlays have been covered by increased returns;
- (ii) the withdrawal of land during pasture establishment;
- (iii) labour availability.

The results should assist extension workers and bank managers in advising farmers on development programmes.

WHOLE-FARM STUDIES, FAR NORTH COAST

This long-term project is continuing satisfactorily. The aims were outlined in last year's report. Detailed development budgets, showing progress to date and revised estimates of future production, have been drawn up for five of the farms.

A preliminary report on the three original farms will be published as an extension booklet in 1968.

BANANA FARM-MANAGEMENT STUDY

At a request by the Banana Growers' Federation and the Australian Banana Growers' Council, management problems in the banana industry are now being examined. The aim is to identify the problems more clearly, to find management techniques to increase the net farm-incomes.

The Bureau of Agricultural Economics has recently reported that less than one banana grower in four earns more than \$2,000 per annum to cover his own labour and management and to provide a return on capital invested. The Bureau survey indicated that the average net farm-income of banana growers in New South Wales is only slightly more than \$1,000 per annum.

Initially a mail survey is being undertaken. This is to obtain background information and data for work on budgeting. The questionnaires were mailed to some 400 growers in May, 1967. The response has been satisfactory; so far about 34 per cent and, through follow-up letters, likely to reach 70 per cent.

While the data from this survey will mainly be used for work on budgeting, a cross-sectional production-function study may also be possible.

SHELL EGGS, DOMESTIC DEMAND-STRUCTURE

The demand-relationships between the three grades of eggs currently sold on the New South Wales market are being studied, to develop stochastic demand-relations. Time series data from the New South Wales Egg Marketing Board form the basis of the study. From the relations, prediction of the effects of price changes, for different periods of the year, on the quantity of the three grades demanded, may be possible. The study could help the marketing authority in its price-policy.

ECONOMIC STUDY OF M.I.A. LARGE-AREA FARMS

This study, outlined in last year's report, should be completed in the ensuing fiscal year. The survey of a stratified sample of 39 properties in the 400-700 acre size-group has been completed. Each farms' programme has been completely analyzed, and input-output data for the various enterprises have been derived.

The matrix has been drawn up and comprises approximately 100 activities and 42 rows. So far, five Honeywell computer test runs have been made, testing the logic of the matrix. Plans are now in hand, with the I.B.M. Service Centre computer, to use parametric land-, labour- and price-programming to satisfy the primary aims of the study.

COLEAMBALLY ECONOMIC STUDY

This continuing study has been referred to in previous reports. This year, records were collected from the 18 co-operating farmers. The records included details of all farm income and expenditure, an inventory of assets and liabilities including valuations done by the Rural Bank and the Water Conservation and Irrigation Commission, and farm-programme information. Complete records dating from 1960 are now available from four farms, from 1961 for four, and from mid-1962 for ten. Issue of a progress report in 1968 is expected.

FARM MANAGEMENT STUDY, BERRIQUIN IRRIGATION DISTRICT

This study, referred to in earlier reports, is nearing completion. The basic objective is to determine optimum farm-programmes in the Berriquin Irrigation District. Effective farm-size on such programmes is also being examined; also the effect of proposed water restrictions on optimum farm-programmes and the on-farm adjustments needed to maintain reasonable farm income after the restrictions are enforced. Two groups of farmers have been surveyed by comprehensive personal interviews.

The first group, 38 "recommended" farmers, were selected because they represented a very wide range of farm enterprises and also were likely to be able to provide reasonably accurate input-output data. This group was interviewed to provide input-output data, to enable compilation of gross margins.

The second group, 22 farmers randomly selected from a list of landholders, were interviewed to obtain data on resource restrictions and to give an indication of present farm programmes.

Later analysis has shown that the two samples of farmers did not differ markedly in farm resources or stocking rates.

Linear programming is being used to study farm programmes. The parametric facility is being used to study the effect of variations in resource restrictions, particularly farm size and fixed labour supply, and in gross margins of individual enterprises.

MOIRA PRIVATE CO-OPERATIVE IRRIGATION SCHEME

Considerable progress has been made in this study, towards optimum development-plans for the group of farmers who have recently commenced irrigating from the private co-operative scheme.

The survey of 45 farmers has been completed and much of the analyses has been done. Input-output data derived from study of the Berriquin scheme will be used to provide enterprises' gross-margins, the two areas being similar. A budgetary approach will compare the farmers' pre-irrigation progress with their proposed post-irrigation programmes. Variable-resource linear programming will be used to compare optimum pre-irrigation farm programmes with optimum post-irrigation farm programmes.

Net benefits from irrigation in the above two sets of assumptions will be determined, and aggregated to provide estimates for the whole scheme.

EVALUATION OF A PROPOSED IRRIGATION SCHEME, BARELLAN DISTRICT

This project, started in 1966, aims to assist a group of farmers who are planning a co-operative private irrigation scheme—by evaluating the profitability of the proposal. By using variable-resource linear programming the value of the study has been increased, with the possibility that the results will be applicable in general to river pumping in the south-west.

All necessary input-output data have been collected and enterprise gross margins have been calculated. Most of the necessary linear programming work has been completed. A report is likely by the end of 1967.

ECONOMICS OF DAIRY HERD REPLACEMENT, NEAR-METROPOLITAN

Using the field survey method to get the needed data, a project has been started to determine the economic efficiency of alternative systems of herd-replacement for dairy farms in a significant portion of the Metropolitan Market Distributing District. The major goal is to provide the dairy farmers with economic advice on various herd-replacement practices.

ECONOMICS OF SOIL EROSION CONTROL

Comparatively little specific information is available on the economic implications of soil erosion control. A series of three investigations has been planned to provide some details of costs and returns. The three comprise:

- (i) An attempt to use the universal soil-loss equation (developed by the United States Department of Agriculture) to provide soil-loss estimates for New South Wales farming conditions. The soil-loss estimates would form the basis for a discounting-model by which soil erosion control measures can be evaluated at the farm level;
- (ii) Some case studies of farms where soil conservation works have been done. The object is to determine the nature of the initial and subsequent costs and returns of the soil conservation practices;
- (iii) A field survey of farmers who have contacted the Soil Conservation Service and had a farm plan prepared and/or had soil works done on their property. The aim of this survey is to investigate: (a) why farmers adopted or did not adopt soil erosion control measures; (b) whether the effects of erosion since adoption or non-adoption have been as severe as expected; (c) how profitable the soil works have been.

POME FRUIT INDUSTRY STUDY

This study has been continued but could not receive a great deal of time and the original data are now seen to have considerable shortcomings. A report on the project is likely to be finished in 1967. The report will cover the economic situation of the pome fruits industry on the New South Wales tablelands but major recommendations affecting the future of the industry are not likely.

ENTERPRISE GROSS-MARGINS, NORTH WESTERN

This project involves direct data-collection from farmers—to determine enterprise costs, fixed and variable, and enterprise gross-margins for several stock and crop enterprises common in the North Western Agricultural Region. The main value will be provision of farm management data for use by extension workers.

WATER DEMAND IN COTTON PRODUCTION

The general aim of this study is to develop means to estimate the demand for irrigation water during a production season, and in particular for cotton production in the Namoi Valley.

Basically there are two parts of the study. Firstly the development of a plant-soil moisture simulation model to determine, using dynamic programming, the optimum control of water supplies over the production season under the present water-pricing policy. Secondly the use of that model to simulate the effect of hypothetical different pricing policies on the optimum use of water in cotton production.

AN ECONOMIC APPRAISAL OF FORWARD MARKETS

A study of the place of contract markets in the marketing process, and their effects on economic efficiency, has been started. The project is primarily analytical. It will try to delineate the relationship between forward markets and the essential aspects of all marketing activity.

PROBLEMS SURVEY, NORTH WEST SLOPES

By mail questionnaire about 350 landholders in the Ashford Shire are being surveyed in an attempt to define farming problems there. The work was suggested by the District agronomist because there is a strip of country from Manilla through Bingara and Ashford where development has been comparatively slow over the last 10 to 15 years. Ashford Shire is typical of the strip. The survey may throw light on specific reasons for the slow development compared with that of adjacent country.

CAPITAL ACCUMULATION AMONG BEGINNING FARMERS

A study of capital accumulation in the northern part of the State has been recommenced following the return from overseas study leave by the research officer concerned. About 80 farms are being surveyed, based on income tax accounts.

Three groups of Government-assisted (War Service Land Settlement) farmers are being studied. These groups began farming at different times; one group in 1949, one in 1952 and one in 1957. They will each be studied for the period from establishment to June, 1967. The basic inquiry is related to problems of capital accumulation and establishment generally. Covariance regression analysis will be used to investigate an investment function, while stepwise regression will be used for factors related to capital accumulation.

BROILER INDUSTRY ECONOMICS STUDY

The objective of this new study is to compare profit-possibilities under two different management systems: the single-batch system; and the system wherein a number of batches, birds in different age groups, are raised simultaneously.

It would be reasonable to forecast the multi-batch system as the more profitable, but this has not yet been substantiated. Further work is needed on the models being used in the study.

REGIONAL LIVESTOCK MARKETS

A study has been commenced in northern New South Wales to determine the degree of correlation, over a period, between livestock prices there and at Homebush. The results will determine the most suitable source of price data, for use in economic projects done in the Northern Region. They will also indicate whether similar studies should be done in other parts of the State. The initial work is being done on beef cattle prices.

PIG RAISING SYSTEMS, COMPARATIVE PROFITABILITY

Comparative profitabilities of bacon, pork and slip-production under systems of 2, 4, and 8 weeks' weaning, in both conventional and slatted-floor housing, are now being studied. Analysis of sensitivity of profits to changes in input and product prices is also likely from the study. Getting satisfactory data is difficult and is likely to delay the project.

AN EXTENSION EVALUATION

An evaluation was made of an extension campaign designed to educate townspeople and beekeepers in the recognition and control of American Brood Disease, following an outbreak of that bee disease in the Bathurst area. A report of the survey has been prepared for publication in *Fatis Review*.

FARM MANAGEMENT ACCOUNTING

The experimental work on aspects of farm management accounting continued but one aspect of it had to be discontinued when the co-operating accountant sold his practice.

Proposed new "production" sections for the recently published Farm Record Book are being tested in the field, prior to completion. The paddock and livestock registers may be available during 1967-68 to supplement the existing financial records and "Daily Farm Activity Record".

DEPRECIATION AND INCOME TAX

Effects of special depreciation allowances on taxable incomes of various sizes and for several different length-of-ownership periods are being studied. The effects, on taxable income and on cash reserves, of making special purchases specifically to reduce income tax commitments, will also be examined.

Advisory, Educational and Extension Activities

EXTENSION SERVICE IN FARM MANAGEMENT

Continued loss of relatively experienced staff again prevented any significant expansion of the Division's extension services in farm management and farm economics. Only one new Regional position for an agricultural economist was filled during the year. This was off-set by resignation of an experienced agricultural economist at another centre.

In light of experience, the limited staff available for regional research and extension in farm management will be concentrated, temporarily, in a relatively few rather than spread thinly over a larger number of centres. This should result in more efficient use of staff, although some areas might for some years remain without an agricultural economist.

The Division continued to provide schools and courses in farm management economics for the farming community. There is heavily increasing demand for this type of extension education, but lacking staff it has not been possible to expand the activities.

IN-SERVICE TRAINING IN FARM MANAGEMENT

The training programme for extension and research personnel of the Department in farm management economics continued, but it too has been restricted through staffing problems.

LECTURES

At Extension Schools, etc. Besides organizing farm management schools already referred to, officers of the Division addressed several schools organized by the Agricultural Bureau, universities, and other organizations. Officers also addressed various professional societies and other organizations on economic aspects of the rural industries.

Courses at Agricultural Colleges. The Division continued to provide a full-time lecturer in farm management at Wagga Agricultural College. He also handles this subject-matter at Yanco Agricultural College.

At Universities. Two officers of the Division gave short part-time courses in aspects of agricultural economics to students in the School of Wool Technology at the University of New South Wales. One of them also gave a short course on agricultural aspects of regional planning to post-graduate students in the Department of Town and Country Planning of the University of Sydney.

POLICY ADVICE

The Division continued to provide advice on economic policy affecting agriculture. It also continued to examine and advise on the position concerning imports and exports of coarse grains, protein concentrates, and other farm requisites.

QUARTERLY JOURNAL

The Division's quarterly journal *Review of Marketing and Agricultural Economics* continued. Besides the contributions by the Division, papers from agricultural economists in other organizations in Australia and overseas were accepted. The journal fulfils in Australia, and overseas, a leading role by disseminating results of farm economics research. It is becoming increasingly well-known overseas and is now generally regarded as one of the leading two Australian journals of agricultural economics.

OTHER PUBLICATIONS

Australasian Bibliography of Agricultural Economics. This, prepared by two former officers of the Division, is now in the final stages of printing. The publication will prove extremely valuable over many years for those engaged in research in all aspects of rural economics.

New "Farm Record Book" Series. This was published during the year and very favourably received by the farming community. Further sections are to be added as opportunity offers.

"Getting Started in Farming in New South Wales". A new edition was issued this year. Overseas demand for this pamphlet continues to increase. It has a very wide usage.

STUDY TOUR BY DIVISIONAL CHIEF

The Chief of the Division late in 1966 spent three months studying developments in meat marketing in North America and Europe.

Marketing Boards and Polls

GENERAL

The Egg, Rice, Wine Grapes, Lemon, and Tobacco Leaf Marketing Boards constituted under the Marketing of Primary Products Act, 1927-1965, continued to fulfil their statutory obligations.

Associated with functions of the Tobacco Leaf Marketing Board, "The Tobacco Leaf Stabilisation Act, 1967" was enacted. The Act, primarily concerned with the control of production quotas, will be administered by the State Board.

Following a successful constitution poll, a Citrus Fruits (excluding Lemons) Marketing Board commenced to function in respect of the Lower Murray Area.

Winding-up of the affairs of the Navy Bean Marketing Board is as yet incomplete.

CONDUCT OF POLLS

The polls conducted this year comprised the constitution poll, and an election of producer representatives, for the Citrus Fruits (excluding Lemons) Marketing Board for the Lower Murray Area, and a constitution poll for the Citrus Fruits (excluding Lemons) Marketing Board for the Central Coast Area. Election of producer representatives to the latter will be in July, 1967.

At the request of the Minister, the Division of Marketing and Agricultural Economics defined the boundaries for the September, 1967, election of four producer representatives to the reconstituted Grain Elevators Board of New South Wales. The Division also assisted the preparation of the rolls and undertook other work involved in this coming election.

Following dismissal of the Molong Pastures Protection Board, the Senior Clerk of this Division was appointed Returning Officer under the provisions of the Pastures Protection Act and conducted an election of Board members.

Marketing Reports and Related Services

The Division fulfilled its statutory functions relative to the Marketing of Primary Products Act, 1927-1965, and continued to collect and disseminate detailed wholesale-market information.

Reports covering supplies, quality, price, and price movements, at the City Municipal Markets (fruit, vegetables, poultry, fish, and cut flowers), Homebush (cattle, sheep, and pigs), Alexandria, Perry Park, and Sussex Street (grain, forage, and hard vegetables) were provided each day the various markets traded.

Press and Radio Daily Service. Market information provided by the Division was broadcast daily by the Australian Broadcasting Commission, including regional relays and inter-State hook-ups, and by some commercial radio stations. The daily press, periodicals, Federal and State government departments and instrumentalities, producer organizations, etc., were furnished with detailed marketing information through the *Daily Wholesale Price Quotations*.

Weekly Marketing Notes. The Division continued to prepare and distribute its *Weekly Marketing Notes*. These comprise detailed reports on stock sales (sheep, cattle, and pigs) at Homebush, prices and supplies of fruit, vegetables, cut flowers, forage, meat, fish, poultry, grain (local and overseas), miscellaneous farm produce and processed products. They also cover cold storage statistics of butter, cheese, and fruit, and include a series of average monthly prices, regularly prepared from Divisional records on a comprehensive range of farm products.

Monthly Surveys. Monthly surveys of wholesale and retail stock-feed prices and wholesale prices of dressed poultry were continued.

Inter- and Intra-State Supply Trends. Records of arrivals into Sydney, by rail and sea, of various primary products from inter- and intra-State sources, were maintained.

General Information Service. Numerous requests were received from State and Federal government departments, banks, and private individuals (in Australia and overseas) for information about prices and prospective markets for an extensive range of primary products.

Crop Reviews and Forecasts. This service continued. Production forecasts were prepared for wheat, oats, citrus fruits, and broom millet.

The regular monthly survey of *New South Wales Pastoral Conditions* and the *Report on Production Trends* continued to be published.

Meteorological Services. A Divisional officer continued as Departmental representative in the State Climatological Committee and as liaison officer between the Department and the Sydney Weather Bureau.

Comprehensive meteorological records and data are maintained in the Division. Meteorological advice and data were provided for officers of various Divisions of the Department and for members of the public, particularly in relation to the effect of rainfall on various farm pursuits.

Representation on Committees

The Chief of the Division continued to act as the New South Wales Government representative on the Australian Tobacco Marketing Board, and the Deputy Chief was alternate member.

During the year the Chief of the Division was also appointed to represent the Director-General in the Organizing Committee for the 13th International Conference of Agricultural Economists. The Deputy Chief continued as a member of the Organizing Committee, assuming the responsibility to organize all excursions and post-Conference tours connected with this Conference in Sydney in August, 1967. The Conference has not previously been held in the Southern Hemisphere.

The Deputy Chief continued as Chairman of the Yass Valley Technical Advisory Committee, with another member of the Economics Research staff as Secretary. The Deputy Chief also remained Executive Officer of the State F.A.O. Committee, and continued as a member of the North Coast Economics Advisory Committee.

Other Economics Research Officers acted in the following capacities: Secretary to the Cabinet Sub-Committee on Drought Relief; Secretary, Standing Committee on Drought Relief; Secretary, inter-Departmental Committee of Inquiry into the North Coast Dairy Industry; Member, Programming Committee for Research and Dairying; Member, Rural Economics Sub-Committee of the Murray Research and Extension Committee; and Member, Data Collection Sub-Committee of the Farm Management Section of the Australian Institute of Agricultural Science.

The Senior Clerk continued as Departmental representative in the Markets Advisory Committee.

DIVISION OF INFORMATION SERVICES

Editing Section

Miscellaneous Literature. The total in this range of literature has been confirmed as 1,219, one more than was reported a year ago, but this is after combing-out 121 titles for discontinuance.

Some 267 printing jobs were prepared, compared with an average of 251 over the last five years. There are 273 publications known to be in need of revision before reprinting. In view of the severity of work needed by many, these would take two years to overtake if the current staff were freed from normal flow of work on periodicals and non-titled matter.

Of the 273 in need of reprinting after revision and/or editing attention, 41 have been revised by authors but await editing attention, 135 are with authors for revision, and the 97 others are not yet revised by authors. The 97 are held in the Editing Section because author revision at this time would have to be repeated by the time the items receive editing attention in preparation for the printery.

The printer delivered 323 publications, as against 240 in the previous year. At 30th June, 1967, there were 56 jobs with the printer, compared with 112 a year earlier.

Roneoed Press Releases. There were 48; 37 less than in the previous year. Most were from the Minister's office.

"Press Copy"—Weekly Sheet. The 52 issues provided 408 press items and 32 blocks. Stereos of the blocks were available for loan to newspapers and other journals.

"Dairy Topics" (two-monthly periodical). The year started with a lag of three issues from 1965-66. Eight issues were delivered this year and a ninth (May-June, 1967) is almost in delivery.

The nine issues averaged 21 pages and six articles. Twenty-four articles were from Dairy Division authors or co-authors, eight from Animal Industry Division, four from Science

Services, four from Plant Industry Division, three from Editorial Section, 13 from other sources including one from Regional Extension Services, and seven were from non-Departmental publications.

November-December, 1966, issue was a special feature production on cleaning milking machines. It included a lift-out wall-chart for dairy sheds. The issue is thought to be the most up-to-date and comprehensive on the subject yet published in Australia or New Zealand.

"Poultry Notes" (quarterly). Four issues were delivered. The last, for April, 1967, was delivered on 18th May.

"Agricultural Gazette of N.S.W." (monthly). Thirteen issues were submitted to the printery, the last of these (September, 1967) on 30th June, 1967. Thirteen issues were delivered by the printery, the twelve months having started with the May and June, 1966, issues awaited.

The Gazette's *Research Section* averaged seven pages per issue as in the previous 12 months.

The Gazette's *mailing list* additions and deletions averaged a net gain of 166 per month, as against 150 per month in 1965-66. The Gazette mailing list currently requires a printing of 22,100 copies.

"Research and the Farmer" (Regional series, irregular). Nos 3 and 4 were published. The contents for No. 5, on tropical fruits research, North Coast Region, was received in June, 1967.

Issue No. 3 was drawn from work at Wollongbar and Grafton Agricultural Research Stations and elsewhere on the North Coast; concerned with tropical pastures, the "whole-farm feed-year" project and other matters affecting dairy farming. No. 4 was from South Western Region and concerned with rice, cotton, fruit, irrigated pastures, sheep, and cattle.

"Veterinary Notes" (quarterly). Instigated by Division of Animal Industry, this periodical was first published in 1965 as a bi-annual but from the March, 1967, issue it has become a quarterly issue. Three issues have appeared in the 12 months.

"Dairy Farming in Australia" (N.S.W. 2nd Edition of the Commonwealth Textbook). The assumed last of the revised or new material went to the Commonwealth Department of Primary Industry in 1965 for publication. But the need of other new material has arisen. By the end of 1966 it became necessary to accept back all the material from the Department of Primary Industry because passage of time had made further revision inevitable. The production schedule now requires that all new or newly revised material be with the N.S.W. Editor in January, 1968.

"Weeds" (textbook). The 1st Edition (December, 1959; 6,500 copies) has been out of print for four years. Printer's proofs for the 2nd Edition are now being checked.

"Pastures" (textbook). Of the 1st Edition (July, 1964; 7,000 copies) there are now only 222 copies in head office stock and a few in stock at Regional offices. Most of the new or revised matter for a 2nd Edition is in the Editor's hands and should be at the printery in July, 1967.

"Trees of N.S.W." (textbook). Second proofs for a new edition are being checked by the author Mr R. H. Anderson, retired, and the Botanist Branch.

Research Liaison Service (Science Publications)

Agricultural Gazette Research Section. The Research Section of the Gazette was maintained. Only 49 research papers were published—an average of 4 per issue—a decline from the 6.5 per issue of the previous year. The decline was partly due to expenditure of more time on the further increased requests by officers for advice on preparation and presentation of research papers to various science journals.

A science paper was published in the Research Section of eight of the 12 issues of the Gazette. The policy is that not more than one science paper shall be accepted for any one Gazette issue. This is to encourage research workers to publish in appropriate science journals rather than the Gazette. With this policy, it would be expected that some Gazette issues would not carry a science paper.

Tutorial Advice to Authors. Authors were assisted in respect of 61 papers. A few were so radically changed after the first comment that they obviously were different papers and were counted again.

Late in the year the Research Liaison Officer started to record time spent on some of the advisory work concerned with authors' preparation of papers. The analysis showed that papers typically require about six hours work by the Research

Liaison Officer in analysis and comment. However the range was wide: some required only two hours and others in excess of 10 hours.

A conference of entomologists and a conference of weeds research workers were addressed by the Research Liaison Officer, on organization and presentation of research papers. Tutorial advice was given also at the Department of Agriculture extension methods school in May, 1967, and at the methods school for 2nd year students in Agricultural Science in the University of Sydney, in August, 1966.

Liaison with Australian Journal of Experimental Agriculture and Animal Husbandry. The Research Liaison Officer corresponded and had personal discussions with the Editor of the Australian Journal of Experimental Agriculture and Animal Husbandry (Melbourne). This helped research workers of the Department to meet the Journal's conditions and maintain the high quality. The A.J.E.A. & A.H. Editor also visited Sydney for a discussion the Research Liaison Officer arranged with a group of officers concerned in research direction and/or the handling of research papers for publication. This was valuable both to the Editor and this Department.

Inquiry Section

Excluding the Home Gardens Advisory Officer's work (see later heading), the inquiry-counter office assistants handled 42,197 requests, compared with 42,301 in 1965-66.

Of the 42,197 requests: 8,679 were telephoned, compared to 8,433 in 1965-66; 14,996 were postal, compared to 16,043 in 1965-66; and 18,523 were in-person, compared to 17,825 in 1965-66.

Publications Distribution

The inquiry-counter office assistants dispersed 829,025 publications, as against 760,699 in 1965-66 and 860,128 in 1964-65. The 829,025 comprised: 183,561 direct to the public, 34,242 to libraries and 20,520 to Departmental offices served by the mailing list for "new/revise/reprinted items", and 590,702 in bulk-parcelled responses to Regional offices' orders.

Sales of Publications

Revenue from sale publications approached \$8,736 as against \$8,000 in 1965-66 and \$12,000 in 1964-65. Of the \$8,736 some \$4,696 was from sales of the *Pastures* textbook. Head office stocks of the 7,000 copies of the 1st Edition have receded from 1,616 to 222 this year. Availability of the new system loose-leaf Farm Record Books since July, 1966, is expected to have a notable effect on revenue in subsequent years. Some major sale items still out of print were the *Weeds and Trees of N.S.W.* textbooks, and the *Home Vegetable Garden* and *Trees on the Farm* bulletins. A new sale publication *The Home Lawn* (39 pages; 20 cents) became available in May, 1967.

Home Gardens Advisory Service

Individual Contacts. Dealing with home garden, allied and commercial floriculturalist enquiries of the sort that the office assistants would be unable to service by references to the literature range, the Gardens Advisory Officer handled 6,886 requests; compared to 5,881 in 1965-66, 6,352 in 1964-65, and 6,544 in 1963-64.

The 6,886 comprised 1,788 in person, 1,369 postal, and 3,729 telephoned requests.

Mass and Group Media. Monthly from August, 1966, to April, 1967, the Gardens Advisory Officer provided a segment of radio 2GB's "At Your Service" session and since April has provided occasional guest broadcasts. He also made two x 15 minutes tape recordings for use by the N.S.W. Royal Horticultural Society in radio 2CH programmes.

The officer provided evening lectures for the West Pymble Garden Club (on "Common Garden Pests"), Mosman Home Gardeners Club (on "Insecticides and Fungicides"), and Manly Orchid Society (on "Safe and Effective use of Insecticides"). a Saturday afternoon pruning demonstration for Blackheath Agricultural Society; a week-day lecture on plant propagation for the Blue Mountains Beautification group at Springwood.

He contributed several items to the weekly *Press Copy*. His bulletin *The Home Lawn* (20 cents) written in 1965 was published this year.

Library Services

The Transfer to State Office Block. As projected, the Department of Agriculture Librarian-in-Charge is now responsible for the combined library services of the six Departments in the State Office Block. The move commenced, for the Department of Agriculture library, on 17th May. A limited service in the new situation was started on 1st May, 1967. Regular

meetings of all personnel of this and other libraries concerned in the move were held throughout the year, and disruption of library services was consequently minimized. In parallel, transfer of periodicals selected for partial or complete transfer to the Public Library of N.S.W. has proceeded throughout the year.

The State Office Block Library. In amalgamating the collections of six Departments—head office Divisions of Department of Agriculture, and the Departments of Public Works, Local Government, Mines, Premier and Treasury—the first major problem has been the inter-filing of catalogues. The catalogue will be in two parts: author and title, and subject. Much remains to be done, and some material is still being identified for transfer to the Public Library as duplicates or unwanted.

An attractive leaflet was produced and distributed to all offices within the State Office Block, to indicate the type of service and to help library users to become familiar with the whole. Orientation talks for Departmental personnel have been projected, to be arranged through Training Officers.

Agriculture's Branch Libraries and Research Station and Country Office Collections. The Veterinary Research Station Library, Glenfield, without a library assistant for three months, received attention from head office; Division of Science Services library, Rydalmere, was inspected for increased workload, a problem increased by the provision of a circulation service; the Wagga Agricultural College library was moved to temporary quarters in November to make way for the Graham Block extension; Seven Hills Poultry Research Station library facilities were inspected, to formulate improvements; and Yanco Agricultural College/Research Station library was subject of a recommendation for appointment of a library assistant.

Allocations for Books, Periodicals and Papers. The C.R. fund B4 allocation for Department of Agriculture books, periodicals and papers remained as in the previous year, but due to higher costs and other factors a supplementary was received.

The Commonwealth Extension Services Grants were used extensively for publications and books for country offices and research stations. Other supplementaries were derived from the agricultural colleges' trust accounts (library).

Ordering and Accessioning. (a) *Orders Placed:* 2,854 items were ordered, or covered by requisitions through local book-sellers or other sources or the N.S.W. Government Offices in London. (b) *Central Library Accessions:* 16,476 items were accessioned, as against 15,504 in 1965-66. The 16,476 comprised 1,133 books, 9,502 periodicals, 4,790 pamphlets, and 1,051 annuals. The 4,790 pamphlets comprised 4,063 in series, 531 for cataloguing and 196 distributed by subject. The per-week average of accessioned items was 316 but for the last five weeks of the year the rate jumped to 639 per week.

Central Library Loans, Agriculture. The loans totalled 27,178, as against 31,433 in 1965-66 and 33,650 in 1964-65. Suspension of service in April/May because of transfer to the new premises largely explains the decrease.

The 27,178 comprised 19,697 periodicals (av. 378 per week) and 7,481 miscellaneous items (av. 143 per week). Of the 7,481 there were 6,218 loans to Department of Agriculture officers and 883 to the libraries of other institutions, while 380 were borrowed for Department of Agriculture officers from other libraries.

No statistics are available at this time for loans at branch libraries of the Department of Agriculture, but these loans are considerable. The branch librarians will maintain statistics for future reports.

Library Information Bulletin. Twelve Bulletins were compiled and distributed. These totalled 379 pages and 4,262 items, as against 250 pages and 2,692 items for the previous year. From September, 1966, the Bulletin appeared in new form and was re-titled "State Office Block Library Bulletin", appropriate to the amalgamation of six Departments' libraries. This explains the increased pages and items.

Reference Work and Literature Searches. The reading lists produced by literature searches undertaken for Departmental officers and external organizations and the public were regularly listed in the Library Bulletin. This year 85 literature searches were listed, as against 68 in 1965-66.

A useful *Bibliography on Agricultural Extension* was prepared, and distributed throughout the Department. It comprised items held in the library and will be continued by supplements.

Photo-copying. The total of jobs was 609, involving 5,720 sheets, as against 778 and 7,259 sheets in the previous year.

New Exchanges Arranged. Exchanges were arranged for further agricultural literature from Canada, Czechoslovakia, Hawaii, Hungary, India, Israel, Japan, United Arab Republic and West Pakistan.

Influence on Development of Translation Service. Arising from a recommendation by Agriculture's Librarian-in-Charge, in his report after attending the 3rd World Congress of Agricultural Librarians and Documentalists, a panel of part-time translators has been established—supervised by the Public Librarian of N.S.W. Translation work for Departments can now be undertaken and is charged against the library vote of the Department concerned.

Audio and Visual Aids Section

Extension Methods Training. The Extension Officer (Photographic and Allied Aids), the Extension Officer (Radio), and Extension Officers (Display Art/Designing) provided sessions at the in-service training school and made in-person training contacts with officers stationed at or visiting head office. For similar purposes, visits were made to country offices in the Western, South Coast and Tablelands, Mid Coast and Hunter, and North Coast Regions.

Cine Film Library Service. The major usage of cine films was at short schools and courses in rural areas. Some 203 cine film programmes were collated and loaned, compared with 225 in 1965–66, and 457 films (not 457 titles) were in these programmes.

Apart from film footages produced for use in field officers' television sessions, only two cine film prints were added to the library this year: "The Lesions of Foot and Mouth Disease" and "Outbreak" (also concerned with foot and mouth disease).

Cine Film Production. Filming of the "Rapid-Development Whole-Farm Feed-Year" project at Uki in the North Coast Region has been completed by Division of Information Services. Editing of the work print is also complete. Recording of the commentary and the matching of original and release prints will be completed shortly.

In collaboration with the Department of Primary Industry and the National Film Unit, the subject-matter and filming situations were organized for a drought film. The field camera work is expected to be complete by the end of 1967.

Field Officers' Photography for Extension. A total of 20,645 photographs by field officers, compared to 19,660 in 1965–66, passed through the Photographic Aids Section of Division of Information Services for attention and return to the field as 35-mm slides. The 20,645 comprised 12,860 colour and 7,785 black and white shots.

Of the 7,785 black and white slides, 6,805 were processed completely in Division of Information Services and the 980 others were prepared as slides from negatives processed by newspaper offices. The latter arose from cases where field officers' photographs had been needed urgently for newspaper illustrations.

Press Photography by Regional Publicity Officers. Arising from the reflex press-cameras supplied to Regional publicity officers were 1,105 negatives 2½ in x 2½ in; 193 negatives processed by local newspaper offices and 912 processed in Division of Information Services. The publicity officers have reported widespread usage by rural newspapers.

Farm Radio. Calculated from officers' monthly reports there appear to have been more than 6,000 broadcasts by officers in country areas. All but three of the 45 radio stations in rural areas have been involved.

Head office radio recordings, although 148 as against 125 in the previous year, still comprised, by intention, an inconsiderable percentage of the Department's use of radio. Of the 148, the Women's Extension Service officers provided 110 as advance-publicity for their rural schools.

Television. In eight of the nine Regions field officers used television regularly. Television channels at Orange, Wagga, Canberra, Leeton, Coff's Harbour, Lismore, and Tamworth have been involved.

Display/Designing Services. Display work was done for the R.A.S. Show, Sydney, and for various country shows, including Grafton, Coff's Harbour, and Orange. Lecture aids and signs were prepared for extension schools and field days and 355 technical illustrations were prepared or were subject of retouching for publication.

Equipment Additions/Commitments. The Section incurred a lot of extra work in the accessioning of various types of equipment subject of major expenditures from the expanded Commonwealth Extension Services Grant. Major items acquired or on order and about to be supplied comprised:

- 54 x 35 mm slide projectors (semi-automatic, cold light) to replace outmoded projectors in country offices;
- 45 overhead projectors, and ancillary "starting kit" materials, to be distributed in the course of tutorial sessions at country offices where previously the officers have had to borrow the Regional headquarters projector;

28 miniature transistorized tape recorders, broadcast quality, to facilitate District officers' acquisition of radio material in the field;

200 tapes for use with the transistorized tape recorders;

44 x 5 watt portable public address systems and microphones to modernize this segment of field officers' group extension work;

9 flash-brackets and flash guns for Regional publicity officers' use on reflex press-cameras;

3 x 5,400 ft video tapes, in a pilot scheme for pre-recording of television programmes in some of the Regions.

Agricultural Bureau and Allied Group Activities

New Branches. Six new branches were formed, viz., Dunedoo, Condobolin, Young, Walgett, Legume, and Myameley-Moira Vale. Narrabri was reconstituted as a "new-look" branch.

Fewer Branches but 80 per cent more Members. One hundred and thirteen branches affiliated with the Advisory Council to 30th June, as against 132 in 1966. Notwithstanding the fewer affiliated branches, the total of affiliated members rose from 2,354 in 1965–66 to 4,290 in 1966–67. Of these, 3,175 subscribed by bank order. The total of affiliated branches might further decline in 1967–68 whilst branch memberships will continue to rise as more "new-look" branches form. These trends are complementary: fewer branches and bigger memberships.

Advisory Council Activities. All Regions except Northern were represented in the State Advisory Council. Five of the 10 Regions were represented by two Councillors, four by one. The 14 Councillors from Regions, the two Women Councillors and the President and Past President comprised a Council of 18.

Industry matters raised for Councillors' attention were appropriately channelled away, for action by the N.S.W. Chamber of the National Farmers' Union. The Advisory Council devoted its time mainly to the Bureau development programme.

The developed demand for schools and courses continued to increase. It has in fact reached a point of causing anxiety in view of the shortage of professional staff. Council discussed ways and means for members to help alleviate the position but in general felt that formulation of school and course programmes and the securing of appropriate lecturers required the services of professional staff. Councillors undertook to do everything possible on the "local front" towards success of schools/courses held in their various areas.

Branches formed along "new-look" lines during and prior to this financial year continued to expand, as shown by the membership affiliation figures. Councillors were perturbed that enthusiasm to form "new-look" branches or to reconstitute some of the old ones has had to be damped down because the current staff would be unable to service more such units.

The Bureau continued its affiliation with the National Farmers' Union (N.S.W. Chamber), the Rural Youth Movement, the Water Research Foundation, the Australian Association of Adult Education, and the Associated Country Women of the World. The Bureau affiliated this year also as an associate member of the Post-Graduate Veterinary Science Foundation.

The 42nd State Congress. This was held at Hawkesbury Agricultural College in 1966 and was opened by His Excellency the Governor Sir Roden Cutler. The programme featured a Rural Finance Symposium, in keeping with the drought and post-drought situation.

State Competition for Beef Cattle Breeders. The 1966–67 Competition, conducted in collaboration with the Rural Bank of N.S.W., attracted 126 entries. A new section, concerned with replacement yearling heifers was important in extension service and met widespread approval. The Competition was won by Maycol Pastoral Co., Narrabri. For their extension value, field days were held in association with the district and state judgments.

Regional/Divisional/District Conventions. Five Conventions on topical subject-matter were held under Regional or Divisional sponsorship: Clarence Divisional Convention at Dorrigo (attendance 112), Mid Western at Cowra (80), South Coast and Monaro at Bredbo (100), Richmond-Tweed at Lismore (200), and Mid Coast and Hunter at "Tocal", Paterson (158).

Branch Activities. The number of routine meetings of branches, in the past devoted to lectures or discussions, etc., continued to decline. The trend towards special feature meetings to hear talks of current topical interest has become more pronounced. Typical were a number of big meetings on "Sources and Availability of Rural Finance", "Farm Water

Supplies", "Wheat Nutrition", and "The Common Market". This type of meeting is customary in the programmes of the "new-look" branches.

Field days continued to figure prominently. Many were organized for interest at branch level. Others were designed for widespread district interest. Examples of the latter were a field day on "Milking Shed Management" promoted by Dorriggo (attendance 130), a field day on "Pasture Establishment" and "Timber Treatment" organized by Legume and District branch (130), the Arcadia-Galston field day on "Orchard and Nursery Practices" (100), and the Goulburn field day on "Pasture Establishment" (120). Numerous other field days drew attendances in excess of 100 people.

Financing External Lecturers, Demonstrators, Advisers. With more frequent major activities organized by Bureau branches, the use of speakers from universities, commercial firms, banks, and government departments has increased. But Department of Agriculture officers continued to be the more frequent lecturers and demonstrators at Bureau functions. As well, they assisted local organization by their advice.

Regional Publicity Assistance. In all Regions where the Agricultural Bureau movement is notable the Department's Regional publicity service has significantly helped to publicize the activities. In the Mid West the Regional Publicity Officer has launched a Bureau newsletter "Jumbunna". This is posted direct to the addresses of the 700 Bureau members in the Region.

Bureau Schools and Courses. The demand for schools and courses continued to increase. Seventy-seven were conducted through the Agricultural Bureau for farmers and pastoralists, compared with 58 in 1965-66 and 29 in 1964-65. Besides, 33 of the 57 schools conducted for rural women by the Women's Extension Service were in association with Agricultural Bureau branches. The details of Agricultural Bureau schools/courses for farmers and pastoralists are:

"Pasture Production and Utilization". Ten were conducted: Bathurst (attendance 90), West Wyalong (80), Inverell (80), Hastings Valley (50), Dunedoo (55), Cowra (40), Boorowa (39), Young (40), Parkes (80), Mudgee (40).

"Schools for Graziers". Three were held: two, sponsored by Peelwood branch, were held at Tuena and drew attendances of 35 and 41; the other, at Inverloch, was organized by South Coast and Tablelands Region of the Department in association with Goulburn branch of the Bureau and other farmer organizations (attendance 70).

"Weed Control" and "Timber Control". Three were held: "Weed Control", Kyogle (46); "Timber and Weed Control", Walgett (46); "Timber Control", Mullion Creek (41).

"Fodder Crops". Two were held: Goulburn (60); Forbes (30).

"Fodder Conservation". Four were held: Tenterfield, Bryan's Gap Branch (26); Mallanganee (40); Coonabarabran (6); Cowra (54).

"Wheat Production". Three were held: Inverell (65); Bingara (55); Baradine (35).

"Wheat Nutrition". Eight were held: West Wyalong (85); Lake Cargelligo (75); Trundle (75); Condonbolin (80); Dubbo (130); Parkes (120); Young (52); Cowra (110).

"Fertilizers". Five schools and one course were held: Cowra (87); Wellington (10); Boorowa (24); Merriwa (50); Coonabarabran (90); Mangrove Mountain, a course of four lectures at weekly intervals (attendance figure not to hand).

"Irrigation". One, at Macksville (39).

"Farm Water Supplies". One, at Mudgee (60).

"Fruit Tree Nutrition". One, at Young (33).

"Animal Reproduction". Eleven schools and one course were held: Inverell (no attendance figure); Bingara (no attendance figure); Boorowa (45); Young (40); Bathurst (46); Coonabarabran (34); Dunedoo (21); Narrabri (no attendance figure); Mary's Mount (no attendance figure); Quirindi, Wallabadah Branch (no attendance figure); Walgett (no attendance figure); Wyong, course of five lectures, at weekly intervals (30).

"Raising Healthy Lambs—Lamb Production". Three were held: Bombala (33); Cooma (52); Goulburn (103).

"Sheep Nutrition". Two were held: Cootamundra (45); Ariah Park (28).

"Cattle Feeds and Nutrition". One course, at Dungog, eight lectures extending over four weeks (47).

"Sheep Diseases". One course held at Manilla, Rushes Creek Branch, four lectures, one per week (28).

"Pig Raiser Schools". Three were held: Forbes (83); Lake Cargelligo (46); West Wyalong (65).

"Meat Marketing". One, at Walgett (52).

"Welding". Two: Blayney, Brown's Creek Branch (no attendance figure); Merriwa (16).

"Tractor Maintenance". One, at Carabost (12).

"Soil Fertility". Two courses, comprising eight lectures, extending over four weeks: Dungog (73); Wauchope (35).

"Rural Finance and Farm Management". One, at Bingara (60).

"Farm Planning". One school at Bingara (43); one course at Dorriggo (28).

Statistics Summary for Bureau Schools/Courses. Figures are available for 69 of the 77 Bureau schools/courses for farmers and pastoralists. Fifty-two of the 69 were sponsored by "new-look" branches and their attendance totalled 2,966, an average of 59. Attendances for the remaining 17 totalled 627, an average of 37. In all, 3,593 people attended the 69 schools/courses for which the attendance figures are on record.

Women's Extension Service

Group Activities: Conventions and Schools. In addition to providing the women's interest sessions at the Agricultural Bureau State Congress, Regional conventions and major field days, the Women's Service conducted a record number of short schools for rural women.

The schools totalled 57. They comprised 33 one-day schools on "Homemaker" topics in association with Agricultural Bureau branches and 19 such schools for the Country Women's Association and other rural organizations, one three-day "Homemaker" school, and four Leadership Schools. Two of the Leadership Schools were of three-days and two were of one-day duration. Attendances at the women's schools totalled 2,044.

Press, Journals, Radio, etc. Press articles for women's interest were contributed to 47 of the 52 issues of weekly *Press Copy*. Fifty-two publicity releases concerned with organization of schools were made through Regional channels. Eight articles and 29 fillers were contributed to the Farm Home pages of the *Agricultural Gazette* and six *Gazette* articles were arranged from guest authors or other sources.

Papers for the reference collections presented to women attending the various schools were prepared. Recipes were supplied for the Department's booklet *Duck Husbandry and Management*. An advisory paper on "Ti-tree Bark Pictures" was written in response to the demand for knowledge of this craft.

One hundred and ten tapes were recorded for Regional offices' use in radio publicity for the schools.

Extension Service/Methods Training Schools and Examinations

Division of Information Services organized, and provided the tutorial staff for, the two-weeks in-service training school held at Hawkesbury Agricultural College and attended by 45 officers; and the two one-week schools for University of Sydney 2nd year undergraduates in Agriculture. The Division provided Extension Principles and Methods sessions for the Commonwealth Poultry Officers' School at Hawkesbury College in December, 1966. It also contributed papers and talks to the Australian Agricultural Extension Conference held in Hobart under the auspices of the Australian Agricultural Council in May-June, 1967.

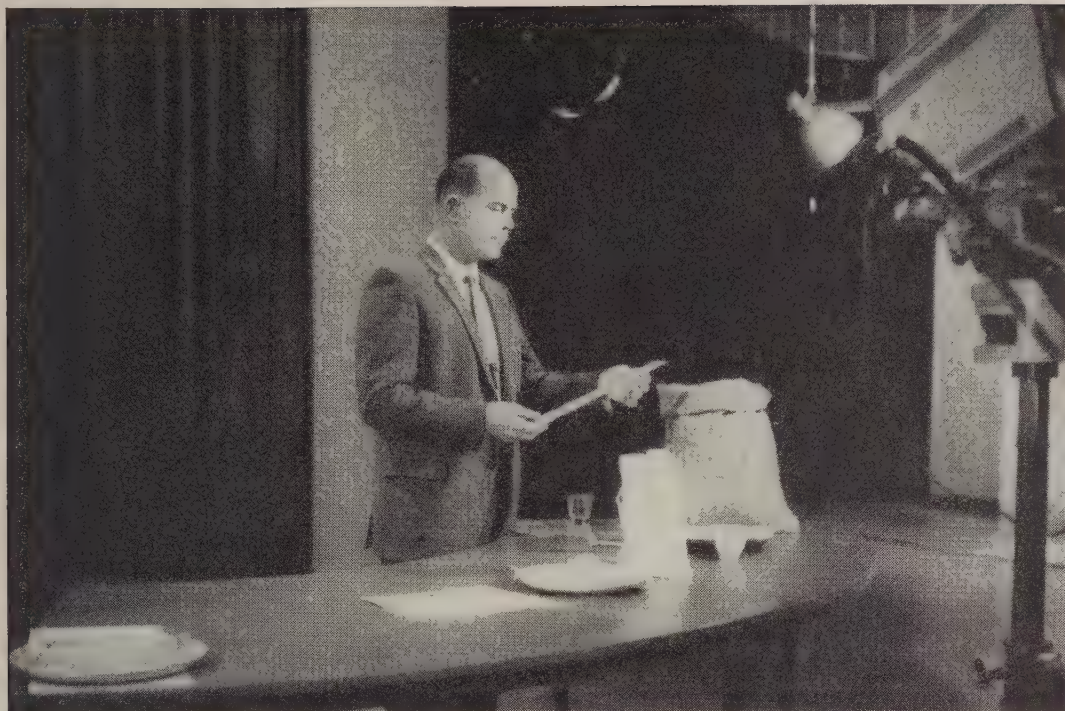
The Regulation 124 Higher Grades examination on Agricultural Extension for Departmental field officers and Rural Youth Movement officers was set and marked by the Divisional Chief.

The Department's Volume of Short Schools and Courses

Short schools and courses wherein the Department was the major organizing and/or staffing force this year reached a total of 203, as against the former record total of 149 in 1965-66.

Details of the 203 schools (showing the place, duration, the co-operating organization or sponsor, the subject-matter, purpose and attendance—as completely as possible from data in hand) have been compiled by the Division for inclusion as *Appendix III* in the Department's Annual Report to Parliament.

Through the Agricultural Bureau and Women's Extension Service and the responsibility for Extension/Methods schools, the Division of Information Services was major agent in at least 137 of the 203 schools/courses.



Seed-treatment advice in the first agricultural telecast at Tamworth

The Department's field staff in North Western Region (Gunnedah headquarters) and Northern Region (Tamworth headquarters) are now jointly providing regular farm-sessions through Channel NEN 9, Tamworth

REGIONAL EXTENSION SERVICES

General

PRINCIPAL EXTENSION OFFICER APPOINTED: EXTRANEIOUS DUTIES

In January, 1967, a position of Principal Extension Officer (Regional Services) was established to provide professional assistance, in head office, to the Chief of Regional Extension Services. Former Western Regional Supervisor Mr B. D. Ament was appointed to the new position, and former Livestock Officer (Beef Cattle) Mr H. T. Harrison was appointed to succeed Mr Ament as Western Regional Supervisor at Orange.

Commonwealth Grants for Extension

The Chief of Regional Extension Services continued to be responsible to the Director-General for administration also of the Commonwealth Extension Services Grant (C.E.S.G.) and Dairy Industry Extension Grant (D.I.E.G.). These Grants, direct to the Department of Agriculture through the Commonwealth Department of Primary Industry, initially made \$325,000 available for 1966-67; \$150,000 under the C.E.S.G. and \$175,000 under the D.I.E.G. Later the C.E.S.G. was supplemented by an additional \$222,800; making a grand total of \$547,800 for the year. The Commonwealth has now combined the two Grants, the whole to be known as the Commonwealth Extension Services Grant, and a substantial increase in total is anticipated to occur in 1967-68.

Drought, Flood, and Bush Fire Committees

The Chief of Regional Extension Services continued also as Chairman of the N.S.W. Standing Committee on Drought Relief, as a member of the N.S.W. Flood Relief Committee and the N.S.W. Bush Fire Committee. In these roles he provided a direct, essential link for the Committees with the field staff of the Department. The field staff, through local knowledge, were a constant source of basic information for the Committees.

Drought-Effects Survey for Australian Agricultural Council

At the request of the Australian Agricultural Council a survey was conducted, on drought-effect on individual property-management and in particular the financial effect. The data are intended to help in planning against effects of future droughts. Extension officers in N.S.W. completed with co-operating farmers some 234 questionnaires in this survey. Each questionnaire involved at least a half-day interview with the farmer concerned. The CSIRO now has the data for analyses.

PERSONNEL IN REGIONS

At 30th June, 1967, there were 521 officers located in country districts for advisory, regulatory, and allied services to primary producers; 468 of them under Regional administration, including 84 in the clerical/office-assistance categories. The total of 521 does not include personnel at the research institutions nor the Agricultural Colleges. The Veterinary personnel are in a separate system of decentralized administration and not included in the 468 who are under Regional Supervisors.

The accompanying tabulation shows the various categories in the 468 "Regionalized" officers, and their distribution amongst the nine Regions.

Increase in establishment in the Regions, overall, totalled 17 this year and comprised three District agronomists, one agronomist-in-training, one District livestock officer (pigs), two livestock officers-in-training, two dairy officers-in-training, two District dairy livestock officers, one fruit officer-in-training, four Regional economics research officers, two fruit inspectors, one herd organizer, one field assistant, and three office-assistants.

OFFICER-TRAINING

Development of University and College Trainees

During their university or college years the Department's trainees acquire 12 months practical experience on and amongst farms. A substantial part of this is acquired by attachment, in the various Regions, to extension and regulatory officers. There are at present 207 such trainees attending Universities or Agricultural Colleges, including an intake of 46 in 1967. The Regions in the past 12 months have played an important role in developing their knowledge of the Department's services.

In-service Development of New Officers

The typical first 2½ to 3 years of a potential extension officers' employment has now been formalized, in terms of where and how his induction-experience shall occur. This now includes a period of six to 12 months intensive-development in one or more of the Regions. The young officer is attached, in the respective Region, to experienced extension officers of other subject-matter Divisions as well as that to which he belongs. He also gets experience in District office-procedures and administration, and in use of mass and group methods of extension.

This year there were 25 such "in-training" officers attached to the Regions.

PERSONNEL IN REGIONS AT 30TH JUNE, 1967

Type of Officer	Regions									
	Total	South- ern	North Coast	Western	South Coast and Table- lands	South Western	North- ern	Mid Coast and Hunter	Mid Western	North Western
Regional Supervisor	9	1	1	1	1	1	1	1	1	1
Agronomist (Extension)	43	4	5	5	5	9	4	3	4	4
Agronomist (Research)	4	..	..	..	1	1	..	2	..	..
Agronomist (In Training)	10	1	2	1	1	1	1	1	1	1
Weeds Officers	2	..	..	1	..	..	1	..	..	..
L.S.O. (S. & W.)	17	3	..	3	2	2	17	..	3	2
L.S.O. (Pigs)	9	1	2	1	1	1	1	1	1	..
L.S.O. (Poultry)	2	1	..	..	..	1	1	..	..	..
L.S.O. (Beef)	9	1	1	1	1	1	1	1	1	1
L.S.O. (Bees)	3	1	..	1	..	1	1	..	..	..
L.S.O. (In Training)	12	1	1	2	1	1	2	1	1	2
L.S.O. (Research)	1	..	..	..	1	..	..	..	..	..
Dairy Officer (Extension)	28	2	12	1	3	2	1	7	..	..
Dairy Officer (In Training)	2	..	1	..	1	..	..	..	..	..
Dairy Office (Livestock)	4	..	1	..	1	1	..	1	..	..
Fruit Officer	12	1	4	1	..	4	1	..	1	..
Fruit Officer (In Training)	1	..	..	..	..	1	..	..	..	..
Machinery Officer	5	1	1	1	..	1	..	..	..	1
Entomologist	2	..	1	1	..	..	..	..	..	..
Locust Officer	1	..	..	1	..	..	..	..	..	..
Bacteriologist	1	..	1	..	..	..	..	..	..	..
Pathologist	..	..	..	..	..	..	..	..	..	..
Economist	14	2	1	2	1	2	3	1	1	1
Publicity Officer	9	1	1	1	1	1	1	1	1	1
Italian Officer	1	..	..	..	..	1	..	..	..	..
Survey Officer (Milk Machines)	5	1	2	..	1	..	..	1	..	..
Seed Certification Officer	7	3	1	..	2	..	1	..	..	..
Fruit Inspector	31	2	10	4	2	8	2	..	2	1
Herd Organiser	9	1	3	..	2	1	..	2	..	..
Field Assistant (D of A)	8	..	1	1	..	4	1	1	..	..
Field Assistant (Grant)	28	2	4	3	6	3	3	3	2	2
Herd Recorder	90	6	28	1	18	10	1	26	..	..
Office—Male	7	1	1	1	1	1	1	1	..	..
Office—Female	82	11	17	10	8	10	6	7	9	4
Total	468	48	102	44	61	67	36	61	28	21

Cases of Specialized Training and Studies

A number of Regional officers have been undergoing specialized training or pursuing certain courses of study, some overseas.

The Mid Western Regional Supervisor completed with honours a one-year Post-Graduate Course in Extension at Brisbane University.

The Western Regional Supervisor was overseas for four months. He attended the 14th International Seminar in Rural Extension held at the International Study Centre, Wageningen, The Netherlands, and for study purposes also spent periods with extension services in western Europe, the U.K., Canada, and U.S.A.

The South Coast and Tablelands and the North Western Regional Supervisors attended a Short Course in Agricultural Extension at the Brisbane University.

A Regional economics research officer returned from study leave in the U.S.A. Whilst there he gained the University of Illinois Ph.D. degree, in Agricultural Economics.

The Northern Region's Publicity Officer is now in the Third Year courses for a B.A. degree, as an external student of the University of New England.

The Mid Western Region's Beef Cattle Officer spent two months studying beef-cattle production in the U.S.A., on a Rotary Travelling Scholarship.

The Western Agricultural Region's Entomologist is on a study tour overseas, concerned with insect pests of pastures and crops and their control.

The nine Regional Supervisors attended a three-days Pesticides School at the Division of Science Services Laboratories, Rydalmere.

The Chief of Regional Extension Services, the Principal Extension Officer (Regional Services) and the Mid Coast and Hunter Regional Supervisor attended the Australian Agricultural Extension Conference at Hobart.

Regional Conferences and Officer-Development

This year, Regional officer-conferences were held in four of the nine Regions; Mid Coast and Hunter, Mid Western, South Coast and Tablelands, and Southern. Officer-development sessions, as well as their discussion of administrative- and subject-matters, were common denominators.

Conference of Regional Publicity Officers

The nine Regional publicity officers met in Sydney for a week of March, 1967. This was their biennial conference, for discussion of extension work and related publicity activities. The publicity officers have, inter alia, a training-role relative to field officers' use of mass and group media of extension.

OFFICE ACCOMMODATION

Office accommodation continued to improve, overall. In general, and with few exceptions, the District offices as well as the Regional headquarters offices have reached a high standard. Staff increases in the past year, and anticipated near future appointments, have raised the need again to expand the accommodation at some centres and also to provide offices at three new centres.

Mass and Group Methods of Extension

PRESS RELEASES AND OTHER PUBLICATIONS

About 2,000 news releases were issued by the Regional offices. Also, 10 well-planned newspaper supplements or specials were prepared by Regional publicity officers and published with the co-operation of major, local newspapers. The specials drew high commendations from editors and readers. The press-type cameras issued to Regional publicity officers have been used to good effect (see details in Division of Information Services report). Their products ensured newspaper acceptance of the articles as well as greater reader interest.

A monthly *Guide for Graziers* is now published by South Coast and Tablelands Region. Mid Western Region has also launched a regular newsletter, in association with Mid Western branches of the Agricultural Bureau. It is despatched direct to each of the approximate 700 Bureau members in the Region.

Meantime the Departmental miscellaneous literature has been well used in each Region to impart technical information. One Region reports a turnover as high as 60,000 items of extension literature.

RADIO AND TELEVISION

Calculated from officers' monthly reports there appear to have been more than 6,000 broadcasts by officers in coun areas. All but three of the 45 radio stations in rural areas have been involved.

In eight of the nine Regions field officers used television regularly. Television channels at Orange, Wagga, Canberra, Leeton, Coff's Harbour, Lismore and Tamworth have been involved.

FARMER SCHOOLS, CONVENTIONS AND FIELD DAYS

Farmer schools and field days serviced by Regional staff continued to increase. They aggregated 450 occasions this year, as against 350 in the previous year, and the attendances totalled in excess of 20,000. Many of the occasions were sponsored by the Agricultural Bureau (see Division of Information Services report) in collaboration with Regional staff.

To cope with special needs, particularly needs arising from the drought and post-drought conditions, series of approp schools were held at major centres; e.g., 21 "Animal Reproduction Schools" and nine "Drought-feeding Schools". In Mid Western Region eight "Wheat Nutrition Schools" were held, to extend in association with Condobolin Research Station staff the results of the central western wheat nutrition research programme.

The Regional Advisory Committees

The nine Advisory Committees, appointed by the Minister and representative of primary industries and areas within the respective Region, continued their important role in offering recommendations to promote and improve extension and research.

This year the Minister attended some of the meetings of the Advisory Committees, to confer in person with members on a range of matters but in particular on measures to be taken to meet landholder needs during the drought.

THE "CO-ORDINATED EXTENSION SERVICES"

The scheme established in 1952 by the then Food Production Advisory Committee, to co-ordinate the extension work of the various agencies in this State, continued to have some effect. It provides opportunity for the field-evaluators of the Rural Bank of N.S.W., field officers of the Soil Conservation Service, Department of Conservation, and field officers of the N.S.W. Milk Board to confer with the Department of Agriculture field staff and co-ordinate their agricultural advice.

Officers of those other institutions have been kept informed of changes in recommendations, by receiving all new or revised publications issued by the Department. Many of the officers have collaborated in the field and, inter alia, assisted at farmer schools and field days promoted in the Regions. There has been similar collaboration with field staff of the Department of Education Rural Youth Organization (former Junior Farmer Clubs of N.S.W.).

Some Selected Notes from Reports by Regional Supervisors

MID COAST AND HUNTER REGION

Increased Dairy Farming Efficiency

This Region provides striking evidence of re-adjustments occurring within the dairying industry. Suppliers to the dairy-produce factories in the Maitland Dairy Officer's District have steadily declined from 1,926 in 1963 to 1,587 in 1967 (a 17 per cent drop), and the drought years 1965 and 1966 have accelerated the decline.

Yet, despite less producers the District's milk output has been well maintained. This is because of the increasing efficiency of farmers remaining in the industry.

Drought Effect on Beef Industry

Beef industry in this Region was hard hit by the drought. The beef cattle total declined by more than 100,000 head. In the latter half of 1966, prime cattle were rare and Maitland

Abattoirs worked only at 25 per cent capacity. Graziers now are re-stocking, and fortunately the calving percentages are back to normal.

An effect of the cattle scarcity has been development of lot feeding with high grain rations. Lot feeding now seems likely to be a permanent feature of the beef industry in this Region.

The Indian Hemp (Marihuana) Eradication Project

Eradication of Indian Hemp continued as a major project. The infested areas along the Hunter River have been kept under surveillance and there have been two full-scale surveys. Spot-spraying has been done as needed. The campaign is progressing effectively, and infestation areas have been greatly reduced, but the goal of complete eradication will demand prolonged effort.

MID WESTERN REGION

Significance of the "New Look" Agricultural Bureau

In this Region there are "new look" Bureau branches at Forbes, Boorowa, West Wyalong, Cowra, Condobolin, Young and Tottenham. They are increasingly effective. One effect is the greater number of farmer schools and courses in this Region, and another is the subject-matter sophistication shown by the members.

For the first time in the near to 60 years history of the Agricultural Bureau in N.S.W., a regional publication for members is now in production. It is product of a joint effort by Bureau office-bearers and the Mid Western Regional Staff, and is distributed from the Mid Western headquarters to each financial member of the Bureau in the Region; near to 700 addressees.

Schools on Results of Wheat Nutrition Research

Through joint programming by the Mid Western Regional staff, the Condobolin Research Station staff, and the Agricultural Bureau Council for the Mid West, a highly successful series of eight one-day schools on wheat nutrition was conducted.

A special newspaper supplement was also produced, to coincide with the series of schools. Seven newspapers published it in February and March. The space freely given by the newspapers amounted to more than 3,500 column inches valued (on a casual-advertising basis) at \$3,868. Circulation, on Audit Bureau of Circulation figures, exceeded 18,000 within the Central West Wheat Belt.

Record Wheat Acreage and Production in the Region

Whereas wheat production in this Region in 1965-66 approximated only 7,000,000 bushels—because of the drought—it amounted to just on 50,000,000 bushels in 1966-67. In 1964-65 it totalled 35,000,000 and, in 1963-64, 25,800,000 bushels.

The sown wheat area in 1966-67 was 1,700,000 acres and this seems likely to be exceeded for the 1967-68 season.

Increasing Pasture-Seed Industry

Pasture seed production continued to increase, mainly in the Cowra area. In 1966-67 some 1,538 acres were passed for certification, compared to 820 acres as recently as 1963-64. The harvest of certified seed amounted to 3,419 bags, as against 1,558 in 1963-64. Meantime the number of contract-harvesters has increased from three to eight, and there are now four cleaning-houses in the Region. Value of certified seed produced at Cowra in the 1966-67 season was estimated as \$166,970.

NORTHERN REGION

Extension Campaign on Re-stocking Problems

Because of the serious drought-effect on livestock numbers, and the likely difficulties in re-stocking, Regional officers planned an extension campaign to assist graziers to meet their problems. Short- and long-term activities were devised.

A schedule of schools based on improvement of livestock re-production rates was implemented in October, in light of the good spring. At 12 centres, half-day educational gatherings were conducted, sponsored by local organizations.

Regional staff also presented a series of three television programmes through the new Station at Tamworth in the spring of 1966, on the livestock reproduction theme.



Demeter Fescue seed-harvest, for Certified seed.

The spring and summer rains in 1966-67 led to remarkable recovery in pasture-seeds production; about 3,000 tons of Certified seed from Registered areas of pasture species.

Television Commitment to Tamworth Channel

The Northern and North Western Regional Supervisors and Publicity Officers conferred this year with the Manager of NEN Channel 9 at Tamworth and have made a programme commitment to be shared by the two Regions.

An unsponsored series of ten-minute programmes will be presented, on alternate Sundays. The series started on 7th May, 1967.

Boom in Northern Region's Wheat Acreage

In the previous year the drought reduced the normal wheat-sowing of 280,000 acres by 50 per cent. Reduction of livestock numbers through the drought, and farmers' appreciation that wheat offered the hope of quick financial recovery, led farmers to prepare and sow about 400,000 acres for the 1966-67 crop. The big harvest revitalized the Region's economy.

Renewed Interest in Pasture Seed Industry

There is renewed interest in production of certified pasture-seed in Northern Region. Two former extension officers now specializing in pasture seed production have helped to set a standard likely to have far-reaching effects on the industry in the north.

Northern Region's seed-production statistic this year included 4,025 inspected acres of phalaris (2,700 bags paddock-sealed), nine acres of perennial rye (58 bags), 52 acres of Brignolles Cocksfoot (176 bags), and 278 acres of Demeter Fescue (588 bags). The certified-phalaris production would approximate 45 tons.

Development of Malting Barley Industry

A barley malting house has been established at Tamworth and is expected to be of real significance to the district. The district, previously producing only a few hundred acres of barley per year, now seems likely to become a substantial producer of malting-grade barley. The maltster expects to process 800,000 bushels in the first year, by drawing barley from Queensland, pending development of local acreage.

NORTH COAST REGION

The Dairy-Farm Feed-Year Financial-Assistance Scheme

Assistance under this scheme, launched by the State Government in October, 1966, is available to all registered dairymen in the Region and to those in the Macleay Shire; about 5,100 farmers in all.

By the end of May, 1967, not less than 2,981 (58 per cent) had made use of the scheme, and the percentage is likely to be 65 by September, 1967.

The substantial rise in dairy-factory produce throughout the Region is partly a result of the good season but it is largely a direct result of better nutrition for dairy cows because of the Feed-Year Assistance Scheme's incentive to farmers.

The Scheme has been assessed by Regional officers as "the most potent extension-tool ever placed in the hands of the Department's extension officers". Their servicing of "old contacts" has multiplied, and to this has been added many farmers who have not previously sought Departmental advice.

Flood Effects

Every river system in the North Coast Region underwent major flooding in June, 1967. In the Richmond River Valley it was the second flood this autumn (two floods in 10 weeks).

Fortunately, few stock were lost by drowning. Civil Defence warnings were in ample time for movement of stock to high ground.

In the Grafton area, a fodder-drop from the air was organized under the direction of the District livestock officer. The "drop" continued for three days; to stock stranded on small areas of flood-surrounded high country. In this way, hay was fed to mobs totalling 4,000 head.

Conferences of Extension and Research Personnel

Besides liaison contacts between individual extension and research officers, biennial conferences have been held to shape Departmental recommendations as affected by research data and extension experience. The recommendations have related to the spring-summer and autumn sowings and been issued at least three months before the season for which they were designed.

The extension research conferences were followed by meetings at Lismore and Coff's Harbour with seed-industry and fertilizer-industry representatives to discuss proposed recommendations. These conferences, with research staff represented, gained invaluable goodwill and co-operation from the industry representatives towards achieving the Regions' extension objectives.

Increased Sugar Production

Big increases in crushed-sugar tonnage were reported by all three mills in North Coast Region. The Broadwater Mill crushed 423,000 tons; 228,000 tons more than in the previous year.

New Officers in North Coast Region

Appointment of an Agricultural Machinery Officer has filled a serious gap in the Region's extension services. Also, there is now a dairy bacteriologist stationed in the Region, at Lismore.

NORTHWESTERN REGION

Effect of the Underground Water Resources and Irrigation

Stimulated by the drought and increased knowledge of the underground water resources, and by the field potential of irrigated crops, irrigation has increased in this Region. The irrigation-farming methods have also improved.

Flood irrigation in the Breeza-Quirindi area has expanded to about 4,000 acres, mostly for maize production. Land values of the irrigable country have risen from \$20 (in 1950) to about \$200 per acre. The increasing values will bring more land under irrigation. At least 50,000 acres could be irrigated in that area. Maize is the main irrigated crop at present, but oil-seed crops and large-scale vegetable production are likely to follow.

In the other main irrigation area of the Region, Wee Waa-Narrabri, the acreage sown to the principal irrigated crop (cotton) was limited to 29,000 acres in 1966-67 by the drought effect on water availability from Keepit Dam (down to 10 per cent of capacity). Increased exploitation of underground water resources, and replenishment of Keepit Dam, would be followed by an increase to 40,000 acres of cotton and development of other crops.

At least 5,000 acres of safflower were sown in the Region. About 50 per cent of the acreage was in Narrabri district, and the area sown to safflower there will increase following establishment of a \$2 million oil-seed crushing plant.

Economics Research Officer Appointed

An economics research officer has been appointed to North Western Region. With consequent more accurate economic data the extension officers expect to be better equipped to meet the demand for a type of advice increasingly sought by landholders faced by the narrowing margins of profit.

SOUTH COAST AND TABLELANDS REGION

Self-reliant Voluntary Organizations

Advent of research extension type organizations and a changing pattern of operation in Agricultural Bureau branches, has brought about a degree of group self-reliance not previously apparent in many farmer organizations. The research extension types of organizations now functioning in this Region are: the Yass Valley Organization (Y.V.O.), Yass; the South Coast Agricultural Research and Extension Council (S.C.A.R.E.C.), Nowra; and the Far South Coast Co-operative Research Extension Organization (R.E.O.), Bega.

Also, a "new-look" branch of the Agricultural Bureau is operating at Goulburn.

The "Operation Tintacks" Project, Yass

Since the inception of the "Operation Tintacks" Project, three project farms only have been developed and plans drawn up for a fourth.

The increasingly urgent need to extend the Project to interest more landholders in the Yass and surrounding districts could not be met under the present conditions—with only one officer for the Project. The Wool Board has responded to the situation by approving that surplus funds from the Project "Vital Statistics of Yass Valley Merino Flocks" may be applied to the appointment of an assistant to the "Operation Tintacks" project officer, Yass. A Livestock Research Officer (Sheep and Wool) was consequently appointed to the position of Assistant Yass Project Officer, early in 1967. He is to assist in the current farm development programmes but, importantly, undertake the limited scale planning of a greater number of farms.

Residential, Graziers' School

A five-day residential school for graziers was conducted by the Region in the mid-winter vacation at St Michael's Agricultural College, Inverloch. It drew 70 enrolments.

"Guide for Graziers"—Regional Newsletter

Demand for the monthly newsletter, *Guide for Graziers*, produced by South Coast and Tablelands Region, continued to increase. The topical material provided by Regional staff for

this newsletter is also used in the Y.V.O. Newsletter. The *Guide for Graziers* is distributed to newspapers and radio stations, but direct also to individual landholders on request. There are now 200 addresses in the mailing list.

Seed Industry in South Coast and Tablelands Region

For certified seed of potatoes, 185 of the 249 acres submitted were passed; and 50 of the 61 acres submitted for approved seed were passed.

Over 1,500 acres of Kangaroo Valley Ryegrass were harvested, for a yield of about 20,000 bushels of certified seed. The potential production as assessed by the District agronomist is 100,000 bushels from 5,000 acres.

New Officers for South Coast and Tablelands Region

This year the South Coast and Tablelands Region gained a District agronomist for Cooma, a District livestock officer (pigs) for Bega, a herd organiser and also a livestock officer (dairy cattle) for Nowra.

SOUTHERN REGION

At First, a Good Season

Rains were good throughout the spring, and growth of improved pasture was heavy. Large quantities of fodder, both hay and grain, were conserved. The Region's Agricultural Machinery Officer was able to advise on a new locally devised technique to facilitate turning of wet bales of hay before stacking.

Record Cereal Production, then Drought

Record yields of wheat and oats were harvested over much of the Region in the 1966-67 season, then conditions deteriorated seriously. From the end of January to 14th June, 1967, rainfall has been barely one and a half inches in the Region. The six months have comprised one of the longest-ever dry spells in the Region for this time of the year. Working of land for cereals has been delayed, the sowings have been delayed and much reduced, and the demands upon conserved fodder have been heavy.

Record Seed Industry Production in the Region

The ideal spring of 1966 led to seed production records, for subterranean clover and phalaris. At the same time, new methods introduced for control of undesirable grasses and weeds in clover areas helped towards the high per acre yield of good quality seed. Further, the prolonged dry conditions in 1967 permitted harvesting over a record period.

Yield of seed from subterranean clover and phalaris was respectively 2,500 and 170 tons.

Deterioration in Staffing

Since inception of Southern Region (the first of the nine) in 1953, the extension staff strength overall has not much increased there. It has in fact decreased in certain categories. For example: the Economics Research Officer recently resigned, at the end of two years' overseas study leave, and this position is likely to remain unfilled for a considerable time; the Livestock Officer (Beef Cattle) who spent half his time on extension work within the Region and half as lecturer at Wagga Agricultural College, is now in a full-time lecturing position at the College, and the Region has been bereft of such officer for over twelve months; the Dairy Officer position at Albury has been terminated. On the credit side, a Livestock Officer (Sheep and Wool) has been appointed to Albury.

SOUTH WESTERN REGION

The dry 1966-67 summer was followed by an almost rainless autumn, and only about 60 per cent of projected wheat acreage was sown.

Schools on Drought Feeding

By early June, 1967, the Pastures Protection Board districts of Hay, Hillston, Balranald, and part Moulamein were declared drought areas.

Drought feeding schools were conducted at five centres in conjunction with Pastures Protection Boards and attendances aggregated 170.

More Irrigation Farms

The number of farms supplied with water for irrigation purposes is rapidly increasing and increasing the demands for extension services.

Work on Australia's largest private co-operative irrigation scheme, at West Corugan, has started. This scheme will supply each of 274 landholders with 155 acre-feet of water annually. The scheme will cost about \$2 million.

In the western part of the Region, the Abercrombie Scheme started to operate this year. Initially, some 4,000 acres will be irrigated, and ultimately 10,000 acres.

The South Side Scheme at Hay, with 12 landholders and 3,800 acres, started in September, 1966. Appointment of an agronomist to the newly created Hay District will provide irrigators with the assistance they need in the transition from dry farming and grazing to highly skilled irrigation practices.

Production Increasing, in Many Respects

Rice. Rice production again increased, from 178,873 tons in 1966 to 211,000 tons in 1967. Market prospects appear to favour continuity of prosperity in the rice industry.

Dairying. In contrast to most other dairying districts in N.S.W., dairy production in the Murray Valley Irrigation District has increased spectacularly. In the past three years the number of cows has increased by 1,000 per year to 42,889.

Fruit Processing. Leeton Co-operative Cannery processed a record 32,000 tons of fruit and tomatoes. Records were broken also in the canning of apricots and peaches.

Cotton. About 1,800 acres of cotton was planted this season. The area is likely to yield 2,250 bales, the best yield result so far in the southwest.

Tomatoes. In 1965-66 an American partnership commenced large scale tomato production in the Griffith district, with 230 acres of processing tomatoes. This area yielded 16 tons/acre. Following that success, 500 acres were put under crop in 1966-67 and 450 of the 500 acres were direct seeded. The yield average has been estimated at 14 tons/acre.

Special Publications

Extension officers in South Western Region contributed to two special publications: *A Guide to Cotton Growing in South Western N.S.W.*, and *Rice Growing in N.S.W., Australia*, issued by the Irrigation Research and Extension Committee. The former is a 50-page special *Farmers' Newsletter*, written as an extension booklet on cotton growing with particular reference to the southwest. It was financed by the Cotton Division of the Riceworkers' Co-operative Mills.

Regional Economics Research Officer's contributions to extension work this year included the issue of "Farm Planning Leaflets" on several topical subjects. The leaflets are means of rapidly informing extension officers concerning survey results which would otherwise remain unavailable until an account of the completed project were published.

Educational Tours

Following implementation of the Wyndham Plan for Secondary Schools the number of tours of the M.I.A. arranged for senior pupils of secondary schools has increased. Four were arranged in the first six months of 1967. Extension officers accompanied the parties in farm visits and addressed pupils on irrigation farming.

WESTERN REGION

New Regional Supervisor

Mr H. T. Harrison, former Livestock Officer (Beef Cattle), Tamworth, commenced as Regional Supervisor at Orange on 24th January, 1967. He succeeded Mr D. B. Ament, on the latter's appointment to the position of Principal Extension Officer (Regional Services) at Head Office.

More Irrigation

With the completion of Burrendong Dam on the Macquarie River, and drought prevailing in the area to be served by the dam, irrigation has exercised the minds of most people.

The area licensed for irrigation in the Macquarie and Bogan Valleys reached 25,000 acres in June, 1966. So far, about 60 per cent of this is being irrigated.

More Wheat Acreage in Western Region

Fifty-two per cent more land in the Dubbo district has been or will be sown to wheat in 1967. Wheat acreage in southern shires in the District increased by 20 per cent, whilst in other shires there have been such increases as Coonamble 100 per cent, Warren 250 per cent, and Bogan 500 per cent. In all, 1,250,000 acres will be sown.

More Effort Against Serrated Tussock

Increased acreages were sprayed with dalapon in 1967 to control Serrated Tussock (*Nassella trichotoma*). The sprayed areas aggregated 1,989 acres, against 450 acres in 1964. Coupled with this effort against the weed is the current work on chemical fallowing and aerial seeding to assist pasture establishment.

Start of Cotton Industry in Western Region

Commercial areas of cotton, a total of 520 acres, were sown on two properties this season. A gin is to be built at Never-tire before the next harvest.

Some Recovery in Sheep Numbers

Sheep numbers increased by about 2½ per cent during the 12 months and restored the tablelands sheep population to about the pre-drought level, but in the western part of Western Region the total is still well below the pre-drought level.

HAWKESBURY AGRICULTURAL COLLEGE

The Development Programme—General

The College is in a period of notable change and development: substantial Commonwealth financial aid reflected in the building programme; important decisions to implement new courses—in poultry husbandry, post-diplomate training in extension, and an extra year for selected students in the dairy technology course; and the rising entry standards and continuing improvements in curricula leading to the broad objective of fully tertiary level training.

MAJOR BUILDING PROGRAMME

Complete renovation of the College Science Block and construction of the dairy research group's building have progressed well.

Commonwealth grants, for advanced education, and State funds, have led to plans for substantial extensions to the Cannery in the 1967-69 triennium; also another residential block, more facilities for the dairy technology course, buildings for the coming poultry husbandry course, and equipment and furniture for these projects.

Stage I of the new Gymnasium commemorating the College 75th Anniversary has been completed. Many donors have contributed, and appreciation of their generosity is recorded here.

NEW COURSES

Implementation of a Poultry Husbandry Technology Course has been approved by the Minister. A Committee is examining the proposal, to make recommendations in detail.

Introduction of a Third Year in the Dairy Technology Course also has been approved by the Minister, and matters relating to its implementation are under examination.

Establishment of a Post-Diploma Course in Rural Extension has also been approved and may be a reality by 1969.

ENTRY STANDARDS AND CURRICULA

Consistent with current trends at Agricultural Colleges, and the College determination to provide tertiary standard training to meet as a primary function the increasingly exacting demands of rural technological services, enrolment preference has been given to students with higher academic levels at secondary schooling and the curriculum improvement policy has been pursued.

The 4th Form School Certificate is still the minimum for enrolment in the Agriculture and Dairy Technology courses, but the big majority of the 1967 intake of students have the Secondary Schools Leaving Certificate or had completed fifth form. By 1970, at the latest, the entrées are likely to be in order of merit, from the Higher School Certificate examination.

Important curriculum changes have been introduced in the past year, but considerable attention must continue—with particular regard for overall course-structures and the requisite teaching facilities. The staff and the Agricultural Colleges Advisory Committee are giving this attention.

The Diploma Courses—General

STUDENT TOTAL

There are 225 students in the three Diploma Courses—Agriculture, Dairy Technology and Food Technology, and 138 (61 per cent) have bursaries, scholarships, traineeships or

other forms of sponsorship. Thirty-one are Public Service Board trainees for the Departments of Agriculture, Conservation and Education.

THE DIPLOMA IN AGRICULTURE COURSE

Students Numbers, etc. There are 173 Agriculture students and 57 are sons of farmers and graziers. In 1967, 81 students were admitted into Agriculture I. Two dropped out later.

In line with higher entrance standards, 57 of the 81 have the Leaving Certificate, 18 the School Certificate plus 5th Form at school, and six have relatively high passes in the School Certificate.

Of the 81, it is of interest that 39 have a definite intention to seek career-positions in Government service or private industry. Of the 34 students whose intentions are indefinite at this early stage, most are likely to seek career-positions. Students with definite plans to go on the land total only eight.

Curriculum Developments. Further changes have been made, especially in First and Second Years, and more are contemplated. The Agriculture course now has a higher content of basic science and a more orderly progression from basic to applied disciplines than at any previous time. The aim is to increase the challenge to students to think for themselves, and add to their capacity in due course to relate principles to the solution of practical problems.

Special emphasis is being given to provision of a more efficient programme of practical training. A plan submitted by Hawkesbury and Wagga Colleges to improve the practical training programme has been endorsed by the Agricultural Colleges Advisory Committee.

THE DIPLOMA IN DAIRY TECHNOLOGY COURSE

Student Numbers, etc. Twenty-three students were admitted into First Year, 1967. Thirty-six is the current student total; 22 in First Year and 14 in Second Year.

The First Year admissions included 13 from New South Wales (eight Dairy Factory apprentices), three each from Tasmania and Victoria, one from South Australia, one from

Singapore sponsored by the Australian Dairy Produce Board, and one from Uganda sponsored by the Department of External Affairs under the Special Commonwealth African Assistance Programme. All of the Second Year students are being assisted but three of the First Year students are freelance.

Curriculum Developments. Theoretical content has been strengthened, without damaging the practical training, by an adjustment in the First Year and better organization of year-round supplies of milk. In winter, in past years, practical training had been limited to market-milk and the manufacture of fancy cheese and some butter.

THE DIPLOMA IN FOOD TECHNOLOGY COURSE

Student Numbers, etc. With fewer candidates for the 1966 Leaving Certificate there are only seven students in First Year. The course commenced in 1951, with seven students. During the years 1951-60 enrolments averaged less than eight per year. From 1961-66 enrolments averaged 13 per year.

The total of Food Technology diplomates since course inception is 112. More than 10 per cent are managers in food-processing firms or have equivalent or higher status.

Development of Facilities. \$300,000 contributed from Commonwealth and State sources will in the near future provide for the Food Technology School additional facilities—laboratories, lecture and study rooms, offices and an enlarged canner processing area.

Food industry and associated firms have continued to assist the course in many ways—including sponsorship of students, donations of equipment and materials, and assistance during tours.

Interesting Statistics, All Courses

STUDENT NUMBERS

Student enrolment statistics from 1956 to 1967 for the three Diploma courses are shown in the following tabulation:

Course	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Agriculture	182	187	187	190	192	187	189	192	181*	180	173
Dairy Technology	34	33	33	32	32	32	31	25	35*	36	36
Food Technology	17	16	17	15	19	25	28	22	23	21	16
Totals	233	236	237	237	243	244	248	239	239	237	225

* At the start of 1965 there were 239 students, but three in Agriculture and one in Dairy Technology withdrew during the year.

EDUCATIONAL STANDARDS OF ENTRANTS IN 1967 AND 1966 COMPARED

Course	Agriculture Percent		Dairy Tech. Percent		Food Tech. Percent	
	1966	1967	1966	1967	1966	1967
Leaving Certificate Pass, or 5th form ..	100	94	90	90	100	100
4th Year (School Certificate) ..	..	6	5	5	..	..
Intermediate Certificate ..	..	..	5	5	..	..
	100	100	100	100	100	100

Diplomas and Passes Awarded. Diplomas and Year passes awarded in 1966 are compared with those of four previous years in the following tabulation:

	1962	1963	1964	1965	1966
Diploma in Agriculture ..	52	53	47	50	58
Diploma in Dairy Technology ..	16	13	11	13	18
Diploma in Food Technology ..	9	13*	11	8	11
Passed 2nd Year Agriculture ..	54	51	49†	57	37
Passed 1st Year Agriculture ..	52	57	65†	36	56
Passed 1st Year Dairy Technology ..	13	12	10	17	18
Passed 1st Year Food Technology ..	12	11	8	12	8

* Includes one 1962 student permitted to attend 1963 final examinations.

† Includes one 1963 student permitted to attend 1964 final examinations.

In 1966, one Class I and three Class II Honours were awarded in Agriculture, three Class II Honours in Dairy Technology and one Class II Honours in Food Technology.

Employment Avenues. Of the 58 Agriculture diplomates from 1966, nine are employed on farming and grazing properties; 17 entered State Departments and three entered other

Government agencies; private firms accepted seven as technical representatives; 14 entered companies associated with agricultural and pastoral industries; two proceeded to University courses; and six went to miscellaneous employment.

The nation-wide appreciation of the Dairy and Food Technology courses was again apparent, through the enrollees from other States and through the employment of many of the diplomates elsewhere than New South Wales. Of the 18 Dairy Technology diplomates from 1966, nine are employed in New South Wales, three in South Australia, two in Tasmania, and one each in Queensland, Victoria, Western Australia and the Philippines. Of the 11 Food Technology diplomates from 1966, seven are employed in New South Wales, two in Victoria, and one each in South Australia and New Guinea—and all are in food-processing industry.

Development of Lecturers

Staff were given appropriate opportunity to attend short-term schools and conferences and specific, personal-development courses. Three lecturers are undertaking correspondence degree courses through the University of New England, one for the Bachelor of Arts, one for the Bachelor of Education (Administration) and one for the Bachelor of Education degree. Another is partaking a teacher-training course sponsored by the Department of Technical Education. Two members of the staff have been accepted as candidates for the M.Sc.Agr. degree, University of Sydney and one is proceeding towards a Ph.D. degree, University of New South Wales.

The College has become an institutional member of the Association for Programmed Instruction, to help lecturing staff to continue to keep abreast of developments in teaching-aids and methods.

Student Extra-Curricular Activities

Extra-curricular activities continued to be an important feature of student life. Positive contributions were made to the social life and welfare of the College by the Students' Representative Council, the Sports Club, the Debating Society,

the Camera Club, the Students' Christian Movement, the College Branch of the Agricultural Bureau and the Hawkesbury Collegians Service Club. The various teams observed the high tradition of College sport.

Short Term Schools and Conferences

The short schools and conferences held at the College this year comprised: the Herd Recorders' School, Dairy Factory Operatives' School, Extension Methods School, Rural Youth School (Pigs) and Rural Youth School (Entomology), Milking-Machine Survey-Officers' Conference, Factory-Foremen Food-Plant School, Pig Raisers' School, Poultry Raisers' School, Agricultural Bureau Congress, N.S.W. Institute of Technology Conference, District Agronomists' Conference, Irrigation School, Technical Education Teachers' Schools (5), Summer School in Apiculture, Commonwealth Poultry Officers' Refresher Course, Child Welfare Officers' School, and the Sheep and Wool Officers' Seminar.

Some College Sectional Operations

DAIRY CATTLE; BEEF CATTLE; POULTRY; APIARY; AGRONOMY

The College Friesian Cattle. Stock from this stud were very much in demand and a long waiting list remains. Thirty-four head were sold, averaging \$165.

The College herd, for both milk and butterfat, was third from top-herd of all breeds in New South Wales—for herds of over forty cows.

The fifteen head of College Friesians exhibited at the 1967 Sydney Royal Show gained six Firsts, ten Seconds, seven Thirds, and five Fourths, also a Junior Champion bull ribbon. The College was also placed Most Successful Exhibitor for the seventh consecutive year.

The College Poll Herefords. At the close of a steer-production demonstration including comparison of feed-lot and improved-pasture finishing, three pasture-finished steers were entered as a pen in the Sydney Royal Show Steer and Carcase competition. This was a student activity. The steers gained the award of Champion "Pen of Steers on the Hoof" and also Champion "Pen of Carcases". The results of the demonstration were published in the 1967 Poll Hereford Annual.

The Poultry Tests. The 5th Pure Breeds Test ended in December, and a report has been published. The 6th Pure Breeds Test started in August, with eighteen entries. Numerically, the entries have been declining in recent years.

The 14th Random Sample Layer Test ended in November, and a report has been published. The 15th Test started in August, with twenty-three entries, and under modified rules providing more reliable samplings.

The 7th Random Sample Broiler Test ended in July and a report has been published. The 8th Random Sample Broiler Test, for 1967, did not eventuate—due to the lack of entries; but a test for which no official results will be published was started in May. The results will be used in the official record of progress of the Australian broiler industry.

The Annual Poultry Farmers Field Day in September drew about 1,500 people. The theme was "Egg Quality".

The Apiary; College-bred Queen Bees. Demand for the Queen Bees continued to increase. A record number, 540, were supplied. These were mainly to New South Wales beekeepers but some were to Victoria, Queensland and Western Australia. Very favourable reports as to their quality have been received from apiarists using these queens.

The queen-rearing section has been expanded, for greater production of improved breeding-stock. Next season selected breeder-queens and some produced through artificial insemination by crossing compatible strains suited to commercial honey production will be released. To assist this work, the Australian Honey Board granted \$1,000 for purchase of extra hive material.

Agronomy Section—Co-operative Research. Work in several disciplines was undertaken with the Universities of New South Wales and Sydney, the CSIRO Divisions of Food Preservation and Plant Industry, the Australian Atomic Energy Commission, other Divisions of this Department, the Departments of Agriculture in other States and in New Zealand, also with commercial firms and with private individuals.

The co-operative, weeds-research programme with Geigy Australia Pty Ltd continued with mutual benefit and satisfaction. Two of Geigy's staff are located at the College.

Detailed technical reports have been submitted to the Chief, Division of Plant Industry by Agronomists responsible for each of the following research programmes: Vegetable Breeding, Pasture Research, Weed Research, Plant Nutrition Research, and Field Crop Research.

Senior Agronomist Mr Grimmatt attended the 10th International Grassland Congress in Finland.

The School of Dairy Technology—Hawkesbury College

Surplus milk intake was the highest on record and provided for excellent practical training of the thirty-six students in all aspects of dairy manufacture. Curtailment of practical training through short-supply of milk is no longer a problem, provided the Nepean Dairy Society contract for weekly supply of 2,000 gallons of skim milk is continued. It is to be annually renegotiated.

Also, surplus whole-milk receivals have been adequate. Record butter-production was achieved. The ice cream price-war affected sales and this reduced the practical training.

Practical training in the market-milk section was as usual more than adequate—due to daily operation. Flavoured-milk manufacture has been discontinued without deleterious effect on practical training.

Adequate practical training was achieved in cheese manufacture, with record production. This year the manufacture of skim-milk cheese was successfully introduced. Demonstrations of manufacture of "fancy" varieties of cheese, cottage cheese and yoghurt continued.

Powdered-milk production was near to a record. Some milk was diverted to cheese-manufacture to allow extra practical instruction in spray-drying and quality-control. Installation of the Recombined Milk Plant is virtually complete, and evaporated-milk and sweetened condensed-milk manufacture will start shortly.

Dairy Research

MANUFACTURING RESEARCH GROUP

Rapid Methods to Determine Composition of Milk. The infra-red milk analyser (I.R.M.A.) was received just before the start of the year. In the first half of the year work was seriously hampered by I.R.M.A. functional difficulties which have since been overcome, but the staff are looking forward to final location of I.R.M.A. in the new research building now nearing completion.

Results to date show good repeatability in any one session of operation but notably more variation from day to day.

Calibration has been established for fat but not yet finalized for protein and lactose. Direct determinations of S.N.F. are not reliable. S.N.F. is determined from protein + lactose + 0.79 (ash).

Preliminary work to determine the effect of preservatives on I.R.M.A. readings indicates that formalin increases the lactose-reading while mercuric chloride does not interfere.

Seasonal Variations in Skim Milk Quality, re Physical and Chemical Qualities of Spray-dried Skim-milk Powder. The trials continued. Results show relatively little seasonal-variation in the milk from this area. With more severe pre-heating, powder suitable for re-combined evaporated-milk manufacture could probably be produced throughout the year.

Estimation of viscosity on recombining, to evaluate the suitability of powder for recombined sweetened condensed-milk manufacture, cannot be done until necessary equipment is available.

Plans for further trials include the weekly manufacture of milk-powder, using various pre-heating treatments.

The possibility of obtaining milk from other areas where production of milk is seasonal is also being investigated.

The Manufacturing- and Keeping-qualities of Processed Cheese. Work on the associated problems continued. The object is to provide a manual on manufacture and control of processed cheese. The manual's first draft is in preparation.

The studies include:

- (a) *Browning, and preventative measures:* work completed;
- (b) *Emulsifying-action of various salts used:* A technique for measuring oil separation has been established. Some commercial emulsifiers have been studied.
- (c) *"Blowing" of cans:* Media for plate-counting of spores has been studied and the causative organism isolated from samples from a company. To overcome this problem studies in progress include (i) effect of blending, (ii) effect of varying the time and temperature of processing, (iii) effect of the antibiotic nisin.
- (d) *A study of blending technique.*

DAIRY HUSBANDRY RESEARCH GROUP

Efficiency of Detergents and Sanitizers. Continuous efforts to duplicate the previously reported results were made. For various reasons it proved impossible to get repeatable results from the detergent tester. The main factors were probably the unreliability of the equipment—some of it five years old, and difficulties in the slide cleaning procedures.

Complete re-appraisal of the equipment and techniques is proceeding. Design of the detergent tester has been revised and some components have been replaced or renewed towards improving the machine's reliability of operation and the repeatability of results. Some acidic detergents are on trial to determine best method of handling the metal slides used in the experiments. Completion of the re-appraisals of equipment and procedures will allow evaluation of commercial detergents, and also investigations into the mechanics of milkstone buildup and metal corrosion associated with milk/detergent/water interaction.

Cold Cleaning of Milking Machines. This project, to test the possibility of using an improved cold foam system to clean and sanitize machines, was done in co-operation with I.C.I.A.N.Z. The N.S.W. Milk Board and some Richmond and Bowral dairymen assisted. Under most circumstances the system failed to control coliform organisms, even with inclusion of an iodophor sanitizer. As a result, the firm has discontinued its attempt to develop foam cleaning of milking machines.

Microflora of the Milking Machine. The Department's section of this project, in associated with Dr McPhillips of the N.S.W. Milk Board was continued. A rinse technique was used to study the microflora of six refrigerated bulk milk collecting farms near Bowral. Little relationship could be found between counts of the rinses and counts of the milk.

A joint paper will probably be submitted for publication when Dr McPhillips has completed his studies on the counts of the milks from these machines taken before and after preliminary incubation.

Testing of Sanitizers. No conclusive work was achieved. The work may be taken up again in the ensuing year.

Milking Machines and Mastitis. Progress on this is not possible pending appointment of a research officer. The forthcoming Mastitis Control Programme adds weight to the need.

Other Activities. The Milking Machine survey continues to form a valuable link between the research team and the farmer. Several air flow meters and vacuum recorders have been serviced.

A Survey Officers' Conference was held at the College in September, 1966. Nine trainees attended a School of Instruction in Milking Machine Testing at the College in February, and were issued with certificates.

The final draft of the Standard of Performance for Vacuum Regulators is now nearing completion. A new model of commercial regulator has been subjected to an accelerated continuous testing procedure, as a check on the regulator and the procedure.

WAGGA AGRICULTURAL COLLEGE

The Diploma Course

Student Numbers. The College commenced its 18th academic year with a total of 134 students. There had been some withdrawals, and some cases of the student being allowed to repeat a year. When second term started a full complement of 134 students was in residence, including six repeating First Year, seven repeating Second Year, and one repeating Third Year. The following comparative table indicates student numbers over the past five years, including numerical distribution as between First, Second, and Third Year:

	1963	1964	1965	1966	1967
First Year	44	54	55	64	63
Second Year	37	32	41	34	45
Third Year	28	33	30	35	26
Totals	109	119	126	133	134

Of the 64 students who commenced in the 1966 academic year, only 38 were admitted to the Second Year in 1967. Also seven repeats, one who withdrew at the end of First Year 1963 for family reasons, resumed studies as Second Year students.

The high failure rate and the number of withdrawals has again caused imbalance between the years. This has presented problems in class sizes and accommodation in the various lecture rooms and laboratories.

Diploma Examinations, 1966. Of the 36 candidates for the 1966 Third Year Final Examination, 35 succeeded (including 14 through a Deferred Examination). Five gained Honours, Second Class. The other student elected to repeat Third Year and is again in residence.

Ex-Students. The total number of Diploma holders since 1951 now stands at 379 including 35 Honours Diplomates. The number of ex-students totals 578, including two who withdrew in first term 1967 and excluding the one who is now repeating Third Year.

Curriculum Matters. No significant change has been made in curriculum structure and content.

Another large First Year (64) necessitated retention of quarter-class demonstrations in basic sciences and most other demonstrations. The largest ever Second Year (45) necessitated the use of "third of class" subdivision for demonstrations. These increases, through demonstration repetitions, are straining the laboratory facilities and the demonstrators. This is particularly so in the Science and Applied Science disciplines. Additional laboratory accommodation and laboratory assistance have become increasingly urgent needs.

Staffing. There has been no change in College Staff establishment, in lecturing positions.

The College was again indebted to the Southern Agricultural Region for provision of an officer to lecture and demonstrate in Apiculture to First Year students. The College was indebted also to Wagga Wagga Technical College for instruction in Woolclassing, Welding, and Surveying, to Wagga Wagga High School for instruction in English Expression, and to Murrumbidgee District Ambulance Brigade for instruction in First Aid.

Practical Training. The Conference at the College in April, 1967, to discuss extra-mural practical training considered that the 12 weeks extra-mural practical experience outside the College was perhaps too much for students to handle. Thought is being given to reducing the commitment. A decision will be made before the 1968 intake of First Year students.

The College fortunately has some 80 progressive landholders co-operating in the scheme, and the number of landowners willing to employ students is increasing. The student work is controlled by the College. Many farmers co-operated in a scheme to provide harvesting experience for Second Year students in the 1966-67 season.

The College again records its indebtedness to the many private farmers who have given unreserved co-operation in whole farm studies in farm management and in general farm operation; during student tours, and by providing the highly valued practical experience for students during vacations.

Students' Extra-curricular Activities. The Australian Agricultural Colleges Sports Contests were held at Wagga Agricultural College.

The College had a very successful season in Riverina Rugby Union. The Colts won their competition, and the 1st and 2nd XV were eliminated only in the Grand Final. Cricket also emerged again as a major College sport.

Other activities included: Debating within the College and in the city; community service in a whole-College clean-up effort at Wagga Wagga Cemetery; and assistance to local civic authorities in bush fire control.

Student Tours. Third Year students made the annual five-day tour of Central Slopes, Southern Tablelands, and Coastal regions early in September, 1966. The Batlow Tour was conducted in November, 1966. Two one-day tours of Coleambally and Murrumbidgee Irrigation Areas were undertaken by Third Year students.

Half-day and one-day visits were made to local and district studs, and to properties for the purposes of Farm Management Surveys and valuation.

Student Experience with Livestock, Show Exhibits. Senior students gained experience as stock attendants and in judging competitions at the Royal Easter Show, the Wagga Wagga Show, the Wagga Ram Show and Sales, the Albury Sheep Show, and the Merino Ewe Breeders competition.

New Buildings and Equipment. As a result of allocation of funds by the Commonwealth Government in terms of the States Grants (Science Laboratories and Technical Training) Act, 1964, and of the States Grants (Technical Training) Act, 1965, extensive building activity has been in progress.

The School of Farm Engineering (estimated cost \$100,000) is very close to completion. Extensions to the Graham Block and the Lecture-Conference Hall (estimated cost \$300,000) are at advanced stages.

Also, \$40,000 has been spent on plant and equipment, greatly improving the facilities for student instruction.

Loan funds in the sum of \$11,000 were spent on construction of a concrete retaining wall around the northern and eastern aspects of the Doman dormitory block. The work is eliminating serious drainage, mud and maintenance problems caused by the original crib wall.

Short Term Schools and Conferences

The 16th Annual Wheat and Sheep Husbandry School for Rural Youth had to be cancelled, when the number of applicants was insufficient. The 15th Annual Turkey Breeders Conference and School was attended by 50 delegates and as usual was highly successful.

Sectional Operations

CROPPING SECTION

Cereal grain yields were the highest ever at the College. They included 5,952 bushels of wheat at an average of 29.5 from 202 acres, 5,831 bushels of oats at an average of 65.5 from 89 acres, and 3,016 bushels of barley at an average of 66.5 from 45 acres.

Grain storage was increased by adding a 1,550 bushel-capacity silo. A feature of the fodder conservation programme was the making of 515 tons of silage, bringing to 655 tons the total of silage on hand at the end of 1966. In the dry conditions of 1967 about half the silage reserved had to be fed to stock.

Cereal hay production was 88 tons. Areas of oats and barley were grown also for green feed. Pasture and lucerne hay were conserved in the spring of 1966, but practically all had to be fed to stock in the dry conditions of 1967.

Over a thousand acres of sown pasture are established. About half the total was topdressed with superphosphate. The lucerne area remains at 130 acres.

LIVESTOCK SECTIONS

Horses

The horses total at 30th June, 1967, was 55. There were four entires, 29 mares, 13 geldings and nine foals.

One mare was sold for \$525. In service of privately-owned mares there were 11 initial services and one free return.

The Stud won "Best Arab Exhibit" Award, the Champion Stallion Award, two Firsts, two Seconds and one Third at the 1967 Sydney Royal Show.

Beef Cattle

There are 77 Stud animals comprising 10 bulls and 67 cows, and 17 in the Grade herd comprising 14 steers and three cows.

Two Stud bulls were sold. Also, one was transferred for Artificial Insemination services and another was sent as a replacement.

Sheep

Dry conditions necessitated complete hand feeding of all breeding stock. At the 1966 Wagga Show the College entries gained four Firsts, two Seconds and one Third—from eight entries.

Dairy Cattle

High quality in the College herd was maintained by the continuing programme of sound breeding, production-recording, selection and culling. Two of the cows were Production-Class Leaders for N.S.W. in the previous year, viz., "Wagga Emperor's Rose" (Senior 2-year-old; Milk and Butterfat), and "Wagga Faithful Fay" (Junior 4-year-old; Milk).

In the 12 months to June 1967, 39 Jerseys completed tests with a production average of 448 lb B.F./cow (6–10 months lactation). This exceeded the 1965–66 achievement by 45 lb B.F./cow and the 1964–65 achievement by 75 lb B.F./cow. Even better results would have been had if irrigated forage-harvested lucerne had been available when the very dry conditions prevailed in 1967.

Teams were again exhibited at the Wagga and Sydney Shows with very good results.

Twenty-one Stud bulls for \$2,755, 13 females for \$920 and nine calves for \$102 were amongst the sales from the Dairy Section.

Pig Section

At 30th June, 1967, there were 119 pigs as against 133 a year earlier. Demand for the Stud pigs increased during the year; 16 were sold.

A new piggery was listed on the schedule for expenditure of funds provided under the Commonwealth States Grants (Technical Training) Act, 1965. Revised costs of other projects, already commenced, caused deletion of the projected new piggery but the latter has been given high priority in the next schedule of expenditure of funds from the same source. The present piggery was built in 1937–38 and students are receiving their practical work in out-dated conditions. Through lack of pen-accommodation only one student project was possible this year.

Poultry Section

Extensions to the chicken-rearing shed were completed, making accommodation for 3,000 chickens to 10 weeks of age, and a 1,000-bird modern laying-cage shed was completed. These comprise stage 1 in the modernization programme mentioned in last year's report.

Air-conditioning of the incubator room would further improve the hatching figures. These have steadily improved since modern equipment was installed.

The 4th Random Sample Test was conducted and results are now available. The first of a series of turkey management trials began in April and results will be available to the industry in October 1967. The 15th Turkey Raisers School was again extremely successful.

Apiary

This Section suffers lack of satisfactory equipment for controlled breeding. To alleviate this, artificial insemination equipment has been ordered.

Experimental work in the Apiary during the year comprised: (a) installation of package bees; (b) a study in artificial incubation in the hot-room; (c) further tests by the plant pathologist from Yanco Agricultural Research Station, on the viability of spores of the Peach Brown-Rot fungus in bee hives during winter.

YANCO AGRICULTURAL COLLEGE AND RESEARCH STATION

College Staff Developments

The College lecturing staff position was strengthened by appointment of Mr K. W. Bannister (previously Supervisor of Training, seconded from Education Department) to Deputy Principal, and Mr J. K. Aspinall (seconded from Housing Commission) to the Farm Buildings Lectureship and Mr M. W. Vallence as Assistant to the lecturing staff.

The Farm Certificate Students

There were 102 students in the 1966 course. Ninety-five of the 102 students completed the year's course and 81 were granted Certificates.

The student enrolment for 1967 was 103, and at 30th June, 1967, there are 93 still present.

Vocations of Ex-Students

Two ex-students are in the School of Agriculture, University of Sydney, also one at Hawkesbury Agricultural College and one at Wagga Agricultural College. Almost 100 per cent of the rest of the ex-students of the Yanco Farm Certificate Course are engaged in Agriculture.

Development of Facilities

An excellent Farm Buildings Workshop and an additional teaching area for Farm Engineering have been completed. Extensive repairs and painting of the older buildings are under way. The Horticultural officers have been re-housed in more congenial conditions.

Tree and garden plantings have been extended considerably, and the Pearson Block surrounds have been completed with planting of lawns and trees and concreting of paths and kerbing.

A "Research Achievement" Highlight

Kulu, a new long grained rice variety bred at Yanco by Rice Breeder Mr D. J. McDonald, was grown commercially this year. Its field performance was much superior to that of the long grain variety Bluebonnet. About 2,700 tons of Kulu were harvested. Production of Kulu will be pegged at 10,000 tons by the Rice Board in future years. Bluebonnet is not expected to be grown in the coming season.

R. M. WATTS, Director-General, 20th October, 1967.

APPENDICES

I. The Accounts of the Department of Agriculture for the year ended 30th June, 1967.

II. The Published Matter of officers of the Department of Agriculture for the year ended 30th June, 1967.

III. Schools and Courses wherein the Department of Agriculture was a major staffing and/or organizing element in 1966-67.

IV. Notes from Staff Branch (on Staff Appointments/Promotions; Staff Numbers; Retirements; Deaths) in 1966-67.

APPENDIX I

The Accounts of the Department of Agriculture

The cost of maintaining the Department of Agriculture is met from the Consolidated Revenue Fund, and the capital expenditure on buildings and permanent improvements to departmentally-owned property is met from the General Loan Account. In addition to the foregoing general classifications of expenditure, the Department is assisted in financing certain specified lines of research and development together with the control of insect pests and animal diseases by levies on industry and by grants from the Commonwealth, semi-governmental and public and private organizations. Operations falling into this category are reflected in a large number of accounts within the general Treasury classification of "Special Deposits Account", some details of which are given later in this Appendix.

COMPARATIVE STATEMENT OF EXPENDITURE

Account	1965-66	1966-67	Increase or Decrease
	\$	\$	\$
Consolidated Revenue Fund	12,637,495.75	13,863,339.89	1,225,844.14 (increase)
General Loan Account	285,087.72	334,498.97	49,411.25 (Increase)
	12,922,583.47	14,197,838.86	1,275,255.39 (Increase)

EXPENDITURE FROM CONSOLIDATED REVENUE FUND

The following tabulation is a comparison of the expenditures from Consolidated Revenue Fund by the functional Divisions of the Department for the last two financial years:

Division	1965-66	1966-67	Increase or Decrease
	\$	\$	\$
Central Administration	3,345,348.85	2,826,322.60	519,026.25 (Dec.)
Science Services	537,236.95	576,472.43	39,235.48 (Inc.)
Plant Industry	587,413.66	737,916.64	150,502.98 (Inc.)
Horticulture	598,041.34	677,886.98	79,845.64 (Inc.)
Dairying	574,816.63	1,241,299.60 (b)	666,482.97 (Inc.)
Hawkesbury Agricultural College	587,327.92	642,968.30	55,640.38 (Inc.)
Wagga Agricultural College	342,372.90	394,704.03	52,331.13 (Inc.)
Research Stations	1,225,982.14	1,355,531.78	129,549.64 (Inc.)
Animal Industry—			
Head and District Offices	2,053,697.32	2,403,844.82	350,147.50 (Inc.)
Queensland Border	236,238.14	249,581.63	13,343.49 (Inc.)
Tick Quarantine Areas	2,104,058.12	2,250,627.31	146,569.19 (Inc.)
Royal Botanic Gardens	444,961.78	506,183.77	61,221.99 (Inc.)
	12,637,495.75	13,863,339.89 (a)	1,225,844.14 (Inc.)

(a) Includes Expenditure on Drought Relief measures:

	\$
Maintenance and Improvement of Public Watering Places in the Western Division	44,996.02
Expenses in connection with Cloud Seeding	85,808.79
Transport Costs of Fodder to Primary Producers in the Western Division	6,128.34
Subsidy on Transport of Stock for re-stocking	87,234.34
Payment to Australian Wheat Board for special movement of Wheat resulting from Drought	69,494.37
	\$293,661.86

as well as—

(b) Assistance to North Coast Dairying Industry	600,000.00
	\$893,661.86

The amount of \$600,000 for the Assistance to North Coast Dairying Industry was carried to Special Deposits Account (No. 99)—“North Coast Dairy Feed Year Assistance Scheme”—comment on which appears later in this Appendix under the section dealing with Special Deposits Accounts.

EXPENDITURE FROM GENERAL LOAN ACCOUNT

Expenditure from General Loan Account for the year was \$334,498.97.

Included in this sum was—	\$
further expenditure on the establishment of the Farm Certificate Course, Yanco (making a total of \$599,773.07 to 30th June, 1967);	49,854.17
the initial payment on the Dairy Research Laboratory (the total cost of which is estimated at \$145,500); and	75,000.00
the purchase of an additional 100 acres of land at Wollongbar	28,000.00

Details of the expenditure during the 1966–67 financial year on the various works financed from the General Loan Vote as as under:

	\$
Division of Science Services, Rydalmere—	
Plant Quarantine Station	829.50
Wagga Agricultural Research Institute—	
Agroonomy Barn	3,200.00
Plant Breeder's Shed	9,478.30
Potting Shed	4,599.50
Hawkesbury Agricultural College—	
Gymnasium	16,841.50
School of Dairy Technology—Dairy Research Laboratory	75,000.00
Wagga Agricultural College—	
Cottage	13,000.00
New Dormitory Block	10,631.00
Alstonville Tropical Fruit Research Station—	
Glasshouse	4,057.00
Condobolin Agricultural Research Station—	
Cottage	1,680.00
Dareton Horticultural Research Station—	
Additional Offices (including District Office accommodation)	27,781.27
Extensions to Irrigation Drainage	14,345.35
Glen Innes Agricultural Research Station—	
Grain Shed	6,159.09
Narara Horticultural Research Station—	
Amenities Building	1,827.00
Cottage—Somersby	710.00
Narrabri Agricultural Research Station—	
Cottage	3,742.77
Machinery Shed	4,558.00
Plant Breeder's Shed (Cotton)	5,000.00
Orange Agricultural Research Station—	
Potato Greening Shed	5,745.00
Tamworth Agricultural Research Station—	
Granary	5,324.00
Water Supply	2,579.00
Trangie Agricultural Research Station—	
Cereal Seed Shed	6,647.88
Wollongbar Agricultural Research Station—	
Acquisition of Land	28,000.00
District Veterinary Laboratory	180.00
Metabolism Shed (Pigs)	8,874.31
Yanco Agricultural College and Research Station—	
Amenities Room	2,571.75
Cotton Gin and Seed Treatment Plant	1,025.50
Establishment of Farm Certificate Course	49,854.17
Glenfield Veterinary Research Station—	
Armidale Veterinary Diagnostic Centre	8,655.00
Laboratories and Conference Room	3,848.48
Queensland Border—	
Cottage—Boggabilla, Goondiwindi	595.80
Royal Botanic Gardens—	
Glasshouse	7,157.80
Total Expenditure	\$334,498.97

OTHER ACCOUNTS

Special Deposits Account

The following is a complete list of accounts and funds within the Special Deposits Account at the Treasury and upon which this Department operates:

Name of Account	Balance as at 1st July, 1966	Receipts 1966-67	Payments 1966-67	Balance as at 30th June, 1967
	\$	\$	\$	\$
Advance to Officers for Purchase of Motor Cars	Dr. 217,019.40	103,831.61	107,072.53	Dr. 220,260.32
Potato Growers' Licensing Act, 1940	1,013.08	3,028.60	3,408.27	633.41
Commonwealth/State Flood Relief Scheme, 1964 ..	50,110.09	.....	74.75	50,035.34
Balance of Salaries Adjustment Suspense Account ..	166,174.68	232,644.71	166,212.30	232,607.09
Commonwealth-State Bush Fire Relief Scheme, 1965	46,990.80	.....	46,990.80	.....
Commonwealth-State Flood Relief Scheme, 1967 ..	.....	100,000.00	.....	100,000.00
Government Printing Office—Working Account and Stores Account and Sale of Publications .....	.....	4,321.13	281.40	4,039.73
North Coast Dairy Feed Year Assistance Scheme ..	.....	600,000.00	300,178.95	299,821.05
Noxious Insects Destruction Account	49,700.85	68,841.83	94,772.67	23,770.01
Commonwealth Grant—State Secondary School and Technical Training Projects financed under State Grants (Science Laboratories and Technical Training) Act, 1964	30,000.00	.....	30,000.00	.....
Swine Compensation Fund	336,479.21	162,274.36	9,989.13	488,764.44
Commonwealth Grant—State Secondary School and Technical Training Projects financed under State Grants (Technical Training) Act, 1965	96,741.02	164,000.00	208,204.47	52,536.55
Hawkesbury Agricultural College Canning Factory Account	3,845.69	3,514.12	2,178.10	5,181.71
Bush Fire and Flood Relief Account (State)	14,137.31	40,000.00	2,500.00	51,637.31
Hawkesbury Agricultural College—Dairying Factory Working Account	101,443.46	401,215.26	437,683.30	64,975.42
Tobacco Industry Trust Account	8,119.95	40,000.00	32,952.35	15,167.60
Pasture Control Account	20,082.74	.....	.....	20,082.74
French Bean Seed Marketing Board of New South Wales—Funds upon Dissolution Account	432.39	92.60	.....	524.99
Potato Marketing Board of New South Wales— Funds upon Dissolution Account	1,078.76	.....	.....	1,078.76
Unclaimed Moneys Account	1,911.87	1,757.87	1,550.26	2,119.48
Commonwealth Grant towards the Promotion of Improved Practices in the Dairying Industry	13,602.86	178,090.44	174,633.43	17,059.87
Commonwealth Grant—Expansion of Agricultural Advisory Services—New South Wales	37,090.11	322,752.43	289,866.76	69,975.78
Cattle Compensation Fund	1,767,163.11	400,476.69	391,713.55	1,775,926.25
V. P. Bragg Scholarship—Wagga Agricultural College	477.47	615.00	562.00	530.47
Wagga Agricultural College Swimming Pool Account	629.48	1,375.50	1,247.72	757.26
Wheat Industry Stabilisation Fund (Disposal) for Research and Extension in the Wheat Industry ..	26,074.48	2,925.00	13,006.81	15,992.67
V. P. Bragg Scholarship Account (Investment)	12,000.00	.....	.....	12,000.00
Wheat Industry Stabilisation Fund (Disposal) for Research and Extension in the Wheat Industry— Investment Account	90,000.00	.....	.....	90,000.00
Additional Poultry Housing for Random Sample Tests at Hawkesbury Agricultural College	Dr. 2,540.96	1,270.48	.....	Dr. 1,270.48
Poll on question of constitution of a Citrus Fruits (excluding lemons) Marketing Board for the Shire of Wentworth and portion of the Shire of Balranald	.....	.....	124.83	Dr. 124.83
Triennial Elections—Lemon Marketing Board of New South Wales .....	.....	81.39	81.39	.....
Tuberculosis Eradication Programme	Dr. 171.10	.....	.....	Dr. 171.10
Triennial Elections—Wine Grapes Marketing Board for the Shires of Leeton, Wade and Carrathool— 1965	Dr. 45.08	52.17	7.09	.....
Apple and Pear Spray Residue Committee—employ- ment of Fruit Inspector .....	.....	300.00	.....	300.00
Australian Dairy Produce Board—Grant for Re- search Projects—				
Bacteriophage Antibiotic Interactions	387.15	222.27	609.42	.....
Composition of Milk	279.09	.....	29.00	250.09
Efficiency of Detergents	959.76	33.07	330.13	662.70
Expansion of Pasture Species Research	Dr. 5,449.27	18,312.20	11,566.20	1,296.73
Expansion of Other Pasture and Animal Research	Dr. 7,675.94	30,393.00	23,692.25	Dr. 975.19
Flood Irrigation Research, Mooneba	Dr. 277.79	1,120.00	372.27	469.94
Milking Machines and Mastitis	320.00	.....	153.40	166.60
Pasture Improvement .....	.....	1,750.00	3,506.24	Dr. 1,756.24
Problems associated with the Manufacture and Keeping Qualities of Process Cheese	734.02	1,620.00	1,382.53	971.49
Recombining Unit—Hawkesbury Agricultural College	20,000.00	20,000.00	32,858.48	7,141.52
Socio-economic Investigations	496.91	16,030.00	15,003.87	1,523.04
The influence of Seasonal Variations in the Com- positional Quality of Skim Milk on the Physical and Chemical Qualities of Spray Dried Skim Milk Powder	2,407.15	6,000.00	5,413.44	2,993.71

Special Deposits Account—continued

Name of Account	Balance as at 1st July, 1966	Receipts 1966-67	Payments 1966-67	Balance as at 30th June, 1967
	\$	\$	\$	\$
Australian Meat Research Committee—				
Upper River Beef Feed Year Research—North Coast.....	2,317.35	24,895.00	21,208.63	6,003.72
Major and Minor element deficiencies in Soil from Beef Areas	1,523.40	2,913.49	3,739.12	697.77
Phosphate Levels in North Coast Soils with specific relation to Summer Legumes	Dr. 901.64	17,059.06	13,919.46	2,237.96
Pasture intake and digestibility Studies—Production of more Beef per acre on Irrigated Pastures	2,473.67	1,600.42	1,605.71	2,468.38
Winter Nutrition on Northern Tablelands	Dr. 336.91	9,917.36	7,439.26	2,141.19
Nature and Organisation of the Australian Beef Cattle Industry	1,290.81	4,261.14	5,754.62	Dr. 202.67
Beef Cattle improvement through Breeding Methods	843.31	7,208.38	5,981.95	383.12
Sod Seeder Development	1,413.92	.....	1,413.92	.....
Inoculants for Summer Legumes	3,479.46	1,100.00	3,435.40	1,144.06
Incidence, Importance and Control of Parasites of Cattle in New South Wales	694.30	4,160.00	4,897.13	Dr. 42.83
Epidemiology and Control of Fluke Parasites of Cattle in New South Wales	1,800.00	1,800.00	48.20	3,551.80
Bloat Research	363.86	6,000.00	4,864.04	1,499.82
Australian Potash Research Institute Grant—				
Investigation into Potassium Status of New South Wales Soils .....	.....	1,000.00	604.38	395.62
Australian Wool Board Grants—				
Adaptive Pasture Research—Southern Tablelands	2,440.99	5,425.00	14,870.72	Dr. 7,004.73
A development project for the high rainfall region of South Eastern Australia	1,106.60	3,909.00	4,107.22	908.38
Aerial Control of Serrated Tussock—Southern Tablelands	Dr. 89.59	1,000.00	351.90	558.51
Aerial Sowing of Pastures	1,412.74	3,603.00	4,079.63	936.11
A Study of Factors limiting Pasture Yield	1,024.94	4,455.00	5,012.52	467.42
Comparison of the lifetime performance of single and twin born Merino Ewes .....	.....	850.00	525.33	324.67
Comparison of Management Systems	810.13	2,674.00	3,570.22	Dr. 86.09
Contribution for Research into Control of Itchmite in Sheep	1.92	.....	1.92	.....
Co-operative Research into Treatment of non-arable Areas—Serrated Tussock Control	1,532.31	400.00	1,385.45	546.86
Economic Investigations of Serrated Tussock Control	4,900.00	.....	69.12	4,830.88
The effect of Pasture Management and time of Lambing on Wool and Lamb Production in the South West Wheat Belt of New South Wales ..	340.62	200.00	3,453.49	Dr. 2,912.87
Efficiency of Wool Production	1,670.54	3,010.00	5,339.23	Dr. 658.69
Fleece Measurement for Selection of Stud Merino Rams.....	Dr. 315.21	7,875.00	13,741.11	Dr. 6,181.32
Fleece Measurement for Selection of Stud Merino Rams—Fees .....	.....	454.35	.....	454.35
Forage Ecology—Research Agronomists Training with Division of Plant Industry—C.S.I.R.O., Canberra .....	.....	1,214.00	.....	1,214.00
Importance of the Ram in Flock Reproductive Performance.....	.....	500.00	21.71	478.29
Influence of rates of stocking and superphosphate applications on the productivity of Merino Ewes grazing improved animal pastures	1,061.99	320.00	835.86	546.13
Influence of season on Ram Fertility	119.37	.....	119.37	.....
Investigation of Black Soil Scarab	1,388.52	1,176.00	27.40	2,537.12
Physiology of Pastures Seeds	1,543.01	3,323.00	4,038.75	827.26
Research into control of Insecticidal Resistance in Sheep Blowfly	1,085.01	5,931.00	5,066.42	1,949.59
Investigation of vital statistics of Yass Valley merino flocks	1,750.40	6,372.00	7,503.97	618.43
Scholarship—P. D. Claxton .....	.....	2,400.00	2,400.00	.....
Scholarship—I. D. Killeen	1,800.00	2,582.00	4,382.00	.....
Scholarship—H. C. Kirton .....	.....	1,200.00	1,200.00	.....
Scholarship—R. J. Roughley .....	.....	3,474.24	3,474.24	.....
Scholarship—A. J. Williams	2,010.00	2,400.00	2,728.00	1,682.00
Sheep Breeding and Pasture Management—relative efficiency at several stocking rates and superphosphate levels	679.63	6,490.00	2,914.27	4,255.36
Skin folds and Ram fertility	644.60	.....	313.83	330.77
Study of some factors influencing efficiency of Root Nodule bacteria	383.07	5,487.00	5,772.75	97.32
The productivity of natural annual pastures at Trangie with and without supplementary areas of lucerne or natural perennial grasses .....	.....	4,660.00	8,910.93	Dr. 4,250.93
Banana Research Committee Grant for Research....	1,279.40	2,320.00	668.63	2,930.77
Board of Tick Control Employees' proportion of contributions to Local Government Superannuation Scheme	13,949.06	37,955.58	40,016.10	11,888.54
Brown Rot Investigations—Trust Fund	734.62	.....	79.97	654.65

Special Deposits Account—continued

Name of Account	Balance as at 1st July, 1966	Receipts 1966-67	Payments 1966-67	Balance as at 30th June, 1967
	\$	\$	\$	\$
Commonwealth Contribution towards cost of Investigation into Excess Spray Residue on Fruit ..	1,074.63	11,600.00	10,660.15	2,014.48
Commonwealth Grant—Milking Machine components testing Station	Dr. 98.05	2,917.70	2,660.79	158.86
Contribution by Australian Meat Board towards Overseas Visit—J. H. P. Dingle	122.50	.....	122.50	.....
Contribution by Australian Wool Board—Training of Livestock Research Officers	235.58	.....	163.02	72.56
Contribution by Industry towards Research into Meat Meal quality at Seven Hills Poultry Research Station ..	358.78	.....	.....	358.78
Contribution by Metropolitan Water, Sewerage and Drainage Board towards maintenance of greens, embankments, &c.—Woollahra and Centennial Park Reservoirs	406.45	700.00	495.84	610.61
Contribution by States towards salary and expenses of Patrol Officer—Grasshopper Control	4,374.16	7,020.00	4,497.44	6,896.72
Contribution to Animal Insect Pest Investigations—Glenfield Veterinary Research Station	754.03	.....	283.77	470.26
Contribution to Pasture Research—Mid-Coast and Hunter Region	44.01	.....	44.01	.....
Contributions towards Development of Tamworth Experiment Station	1,350.23	.....	.....	1,350.23
Contribution towards establishment of Library at Agricultural Research Institute, Wagga	16.62	.....	.....	16.62
Contribution towards publication of an Australian Bibliography of Agricultural Economics	5,100.00	.....	.....	5,100.00
Department of Agriculture—Suspense Account	27,954.11	4,464,513.14	4,437,471.57	54,995.68
Donation by I.C.I.A.N.Z. towards Pasture Fertilizer Nitrogen Investigations	493.35	.....	.....	493.35
Geigy Agricultural Chemicals—Contribution towards Weedicide Research Project at Hawkesbury Agricultural College	120.22	79.78	.....	200.00
Grant by Australian Apple and Pear Board for co-operative programme with C.S.I.R.O. on Pest Management in Pome Fruit Orchards .....	.....	8,950.00	6,997.98	1,952.02
Grant by Australian Honey Board for Hive Equipment for Departmental Apiaries (operating expenses) ..	.....	1,000.00	16.40	983.60
Grant by Australian Honey Board for overseas visit—A. A. Clemson .....	.....	1,000.00	1,000.00	.....
Grant by Australian Honey Board for purchase of a Truck	355.75	.....	355.75	.....
Grant by Australian Honey Board for Post-Graduate Training—G. L. G. Lee—Travel in U.S.A. ....	.....	800.00	.....	800.00
Hawkesbury Agricultural College Egg Laying Competition Prize Fund	1,240.75	1,915.10	1,714.48	1,441.37
Hawkesbury Agricultural College—Trust Account ..	9,233.84	19,738.46	18,010.34	10,961.96
Legume Inoculant Association—Contribution towards Research and Service in the field of Rhizobiology ..	5.45	.....	.....	5.45
McGarvie Smith Institute—Contribution towards facilities for Glenfield Veterinary Research Station ..	624.25	.....	.....	624.25
Manning District Agricultural Research Council—Contribution for Pasture Research in the Manning District	217.62	2,000.00	1,565.05	652.57
Overseas visit—B. Owen French	4,000.00	369.57	4,369.57	.....
Overseas visit—G. R. Gregory	1,500.00	2,500.00	3,966.40	33.60
Overseas visit—N. C. Lloyd—Contribution from New South Wales Apple and Pear Growers' Association .....	.....	1,200.00	.....	1,200.00
Pender, W. S.—Memorial Fund—Interests on Bonds ..	219.49	118.00	.....	337.49
Reserve Bank of Australia Grant from Rural Credits Development Fund for Dairy Farm Development on alluvial and chocolate basalt soils in Richmond Valley	937.51	3,342.00	2,972.34	1,307.17
Reserve Bank of Australia grant from Rural Credits Development Fund towards Whole Farm Feed Year Studies on red basalt soils	1,673.07	.....	554.18	1,118.89
Rice Research Laboratory, Yanco	45.00	.....	.....	45.00
Shannon Vale Nutrition Station Working Account ..	34,364.24	14,018.36	11,716.04	36,666.56
The Sulphur Institute of U.S.A.—Grant for compilation, &c., of results of U.P.S.E.T. Trials ..	1,592.34	.....	1.64	1,590.70
Tobacco Extension—Grant to finance additional extension work	5,566.56	.....	3,699.57	1,866.99
Tropical Fruit Research Station—Donation by Banana Growers' Federation	4,680.07	.....	451.60	4,228.47
Unclaimed Salaries and Wages	1,369.03	3,972.84	4,468.66	873.21
Unemployment Relief Grant, 1965-66	1,614.22	.....	1,614.22	.....
Unemployment Relief—Grant for Drought Relief, 1966-67 .....	.....	15,000.00	15,000.00	.....
Wagga Agricultural College Trust Account	4,065.91	8,171.87	6,098.85	6,138.93
Wallin, D. E.—Trip to U.S.A.	3,704.01	1,368.66	5,072.67	.....

Special Deposits Account—continued

Name of Account	Balance as at 1st July, 1966	Receipts 1966-67	Payments 1966-67	Balance as at 30th June, 1967
	\$	\$	\$	\$
Wheat Industry Research Committee of New South Wales—Grants—				
Breeding of improved Wheat Varieties for Irrigation Areas.....	34.00	4,800.00	4,797.20	36.80
Contribution of Legumes to the productivity of Wheat Soils in Northern New South Wales	3,068.29	.....	2,851.28	217.01
Controlled Environment Chamber for Frost Re- search	639.50	.....	240.91	398.59
Expanded Wheat Research Projects—Wagga Agri- cultural Research Institute—Agronomic Survey ..	Dr. 6,467.23	22,584.00	18,286.92	Dr. 2,170.15
Extensions—Laboratories—Agricultural Research Institute, Wagga .....	.....	10,000.00	.....	10,000.00
Genetic analysis of Physiological Components of maturity of Wheat	3,095.83	3,600.00	4,978.20	1,717.63
Glasshouse for Cytogenetic Investigations	984.00	4,000.00	.....	4,984.00
Growth, Development and Yield of Wheat Varieties in relation to date of sowing and environment ..	1,756.25	.....	760.36	995.89
Investigation of Black Soil Scarab	1,741.52	.....	1,236.04	505.48
Laboratory Equipment—Wagga Agricultural Re- search Institute	568.40	.....	.....	568.40
Machinability of Doughs	176.00	.....	.....	176.00
Purchase of Solarimeter	104.20	.....	.....	104.20
Skeleton Weed Research	524.29	3,000.00	1,893.40	1,630.89
Soft Wheat Quality Programme—Central West ..	2,488.38	.....	58.35	2,430.03
Soil Fertility.....	Dr. 342.63	3,110.00	2,794.60	Dr. 27.23
Travel and Capital Expenditure—Dr A. T. Pugsley and Mr G. M. Halloran	431.38	.....	.....	431.38
Wheat Breeding—Temora	400.00	.....	.....	400.00
Wheat Research in the Central West	4,988.97	25,734.00	28,666.53	2,056.44
Wheat Industry Research Council Grant—				
Capital Grant for Extensions—Agricultural Research Institute, Wagga.....	10,520.34	.....	2,370.00	8,150.34
Critical Levels of Soil Nitrogen in the Southern Wheat Belt .....	.....	3,656.00	2,454.10	1,201.90
Economics of Segregation and Storage of Wheat ..	291.02	5,654.17	4,788.30	1,156.89
Growth Analysis of Wheat in relation to Develop- ment and the Natural Environment.....	.....	10,380.00	8,657.76	1,722.24
Improvement of Durum Wheat Varieties	2,756.49	3,990.00	5,703.79	1,042.70
Investigation into possibilities of Segregation of Wheats on the basis of Quality—Wheat Grading Survey	1,700.16	.....	1.58	1,698.58
Investigation of Varietal Differences in the Major Components of Baking Quality	3,700.00	3,000.00	6,446.00	254.00
Manufacture of New Cereal Plot Header .....	.....	1,950.00	984.12	965.88
Overseas Visit—E. G. Cuthbertson .....	.....	2,500.00	2,500.00	.....
Overseas Visit—A. N. Smith .....	.....	2,500.00	1,841.89	658.11
Photo-period and temperature studies.....	Dr. 28.74	177.94	149.20	.....
Seed Counter for Durum Project .....	.....	550.00	.....	550.00
The Chemistry of Soil Nitrogen in relation to Wheat Production .....	.....	1,200.00	.....	1,200.00
The use of First Generation Hybrid Seed for Com- mercial Wheat Production.....	804.62	3,581.45	3,987.37	398.70
Wheat Frost Injury—Biochemistry of Resistance Mechanisms .....	.....	1,097.00	150.37	946.63
Wheat Frost Research—Overseas Travel—W. V. Single	721.68	170.90	143.94	748.64
World Wheat Collections—Australian Conference Yellow Dwarf Virus	500.00	.....	500.00	.....
.....	262.77	200.00	301.79	160.98
Yanco Agricultural Research Station Trust Account	5,593.36	7,646.55	4,854.63	8,385.28
\$	2,884,572.11	7,829,894.24	7,290,547.43	3,423,918.92

Commonwealth Grant for State Secondary School and Technical Training Projects

This grant has been given under the provisions of the Commonwealth States' Grants (Technical Training) Act, 1965. It is a three year plan, involving a total expenditure of \$600,000 on technical training facilities.

The 1965-66 financial year was the first of the triennium and the table hereunder shows the accounting for the grant to 30th June, 1967:

1965-66—	\$	\$	\$
Receipts			200,000.00
Expenditure			103,258.98
Carried forward			<u>\$96,741.02</u>
1966-67—			
Receipts			164,000.00
Total Funds for 1966-67			<u>\$260,741.02</u>
Expenditure:			
Buildings—			
Hawkesbury Agricultural College—			
Science Block Renovations		75,015.27	
Wagga Agricultural College—			
Extensions to Graham Block	48,789.75		
Glasshouse	320.20		
Animal Nutrition Unit	4,307.30		
Welding Workshop Extensions	2,510.51		
Wool Classing Unit	565.00		
Engineering and Farm Machinery Demonstration Unit	<u>30,313.50</u>		
		86,806.26	
Yanco Agricultural College and Research Station—			
Metalwork and Farm Building Instruction Workshop		16,253.33	
Total Cost of Buildings		<u>\$178,074.86</u>	
Equipment—			
Hawkesbury Agricultural College	13,369.56		
Wagga Agricultural College	<u>16,760.05</u>		
Total Cost of Equipment		30,129.61	
Total Expenditure			<u>208,204.47</u>
Balance carried forward			<u>\$52,536.55</u>

Swine Compensation Fund

Balance as at July, 1966	\$	336,479.21
Receipts—Stamp Duty		162,274.36
		<u>\$498,753.57</u>
Payments—Swine Compensation		9,989.13
Balance as at 30th June, 1967		<u>\$488,764.44</u>

Cattle Compensation Fund

Balance as at 1st July, 1966	\$	\$	\$	1,767,163.11
Add Receipts—				
Levy		210,492.31		
Sale of Stamps		145,000.79		
Interest on Accumulated Funds		<u>45,000.00</u>		
			400,493.10	
			<u>2,167,656.21</u>	
Deduct Payments—				
Compensation		364,125.42		
Administrative Costs—				
Legal Costs	16.41			
Allowances to Secretaries of Pastures Protection Boards ..	5,326.00			
Department of Agriculture	<u>22,262.13</u>			
		27,604.54		
			391,729.96	
Balance as at 30th June, 1967			<u>\$1,775,926.25</u>	

The following statistical information is furnished in connection with the payment of compensation amounting to \$364,125.42:

Disease	Claims			Animals			Payments		
	Reg 5	Reg 6	Total	Reg 5	Reg 6	Total	Reg 5	Reg 6	Total
Tuberculosis	786	325	1111	2,061	525	2,586	\$ 78,507.54	\$ 39,720.36	\$ 118,227.90
Cancer	3,414	304	3,718	4,457	370	4,827	124,712.58	20,021.47	144,734.05
Actinomycosis	2,436	8	2,444	2,844	8	2,852	77,868.16	240.56	78,108.72
Actinobacillosis	678	7	685	861	7	868	20,198.77	385.57	20,584.34
Pleuro pneumonia contagiosa	2	—	2	2	—	2	200.00	—	200.00
Tick Fever	32	—	32	48	—	48	2,073.10	—	2,073.10
Johne's Disease	4	—	4	9	—	9	197.31	—	197.31
Trichomoniasis and Vibriosis } NIL Claims									
Total	7,352	644	7,996	10,282	910	11,192	303,757.46	60,367.96	364,125.42

COMMONWEALTH EXTENSION GRANTS

In former years the Commonwealth Grants for Extension Services were accounted for in two distinct parts, viz—

Commonwealth Dairy Industry Extension Grant; and

Commonwealth Grant—Expansion of Agricultural Advisory Services.

A new scheme was evolved during the 1966–67 financial year and as a result an additional grant of \$167,150 was received together with the regular grants for the Dairy Industry Extension Grant (\$178,000) and the expansion of Agricultural Advisory Services (\$150,000).

These three grants ran concurrently during the year and the first accounting for the new scheme appears as the third table hereunder with the title "Commonwealth Extension Services Grant". As the Commonwealth will be making one grant only, combining all Extension Services, for ensuing years the grant will be accounted for in the one Account titled "Commonwealth Extension Services Grant".

Commonwealth Dairy Industry Extension Grant

The first grant was received in October, 1948. Expenditure to 30th June, 1967, has amounted to \$2,625,830.50, details of which are—

Item	1948-49— 1965-66	1966-67	Total
	\$	\$	\$
Organising Officers	404,179.13	30,605.58	434,784.71
General Publicity	248,886.04	15,230.91	264,116.95
Demonstrations	385,270.81	12,899.70	398,170.51
Competitions	14,874.73	....	14,874.73
Field Days	177.56	....	177.56
Herd Recording	798,228.85	71,200.00	869,428.85
Artificial Insemination	120,151.52	....	120,151.52
Statistical Work	36,068.18	....	36,068.18
Herd Surveys	52,330.67	....	52,330.67
Punch Card Equipment	69,421.22	2,189.50	71,610.72
Milking Machine Survey	149,957.86	25,492.91	175,450.77
Milking Machine Testing Station	9,765.44	....	9,765.44
Survey—Infertility in Dairy Herds	22,243.61	....	22,243.61
Agricultural Trainees	96,000.00	16,000.00	112,000.00
Sire Survey	11,558.38	978.46	12,536.84
Testing Stations—Air Flow Meters	498.21	....	498.21
Overseas Visits—Departmental Officers	25,386.40	234.83	25,621.23
Publication of Book—Weeds	6,000.00	....	6,000.00
Total	\$ 2,450,998.61	174,831.89	2,625,830.50

Commonwealth Grant—Expansion of Agricultural Advisory Services

Accounting for this grant from 1948 to 30th June, 1967, is as under:

Item	1948-49— 1965-66	1966-67	Total
	\$	\$	\$
Crop and Pasture Demonstrations	186,023.99	1,488.99	187,512.98
Livestock Demonstrations	73,096.02	6,161.67	79,257.69
Horticultural Demonstrations	44,049.88	4,285.35	48,535.23
Agricultural Machinery Demonstrations	97,300.19	24,026.48	121,326.67
Irrigation Equipment and Demonstrations	2,201.64	....	2,201.64
Field Assistants and Motor Vehicles	642,681.39	59,749.48	702,430.87
Extension Aids Equipment	101,895.53	1,788.98	103,684.51
Publicity Officers	351,086.37	52,808.97	403,895.34
Production of Agricultural Films	5,741.71	....	5,741.71
Production of Agricultural Publications	81,490.72	8,094.24	89,584.96
Purchase of Books	27,589.45	653.35	28,242.80
Overseas Visits of Agricultural Officers	24,822.67	....	24,822.67
Agricultural Trainees and Cadets	171,078.52	12,930.75	184,009.27
Administration	26,048.39	1,955.48	28,003.87
Water and Soil Testing	12,318.82	371.32	12,690.14
Total	\$ 1,847,425.29	174,315.06	2,021,740.35

Commonwealth Extension Services Grant

The first year's accounting for this Grant is:

Item	1966-67
	\$
Research Officers	3,861.61
Extension Officers	106.42
Inspectors and Laboratory Assistants	833.49
Equipment	24,817.25
Motor Vehicles	4,719.55
Buildings	28,525.00
Material for Demonstrations	212.68
Extension Aids	11,786.37
Publications and Books	12,123.25
Conferences Training and Visits	28,566.08
	\$115,551.70

Noxious Insects Destruction Account

The Noxious Insects Act, 1934, provides, inter alia, for striking a levy under specified conditions. Monies received from the levy are paid into Special Deposits Account and are applied by the Minister for the purposes of the Act.

The 1966-67 Statement of Receipts and Payments is as under:

RECEIPTS		PAYMENTS	
	\$		\$
Balance as at 1st July, 1966	49,700.85	Poisons, Materials and Sundry Purchases	64,268.33
Levies	28,841.83	Contribution—Australian Locust Patrol Service	5,670.00
Repayment Treasury Advance	40,000.00	Helicopter and Aircraft Charter and Aerial Spraying	24,834.34
			\$94,772.67
		Balance as at 30th June, 1967	23,770.01
	\$118,542.68		\$118,542.68

Potato Growers' Licensing Act, 1940 (as amended)

Transactions on this account for the year 1966-67 were as follows:

RECEIPTS		PAYMENTS	
	\$		\$
Balance as at 1st July, 1966	1,013.08	Grants to Potato Growers' Association	2,970.00
Licence Fees	3,028.60	Administration Costs	438.27
	\$4,041.68	Balance as at 30th June, 1967	633.41
			\$4,041.68

Shannon Vale Nutrition Station—Working Account

The following is the Statement of Receipts and Payments for the year ended 30th June, 1967:

RECEIPTS		PAYMENTS	
	\$		\$
Balance as at 1st July, 1966	34,364.24	Wages	3,729.17
Sales of Wool	12,044.38	Shearing	861.93
Agistments	7.57	Workers' Compensation Insurance	110.21
Sale of Sheep and Sheep Skins	1,966.41	Payroll Tax	90.72
Refund Returnable Containers	12.00	Freight and Cartage	433.67
		Motor Fuel	237.06
		Vaccines and Drenches	2,647.93
		Fodder	1,924.91
		Equipment	526.39
		General Supplies	951.10
		Plant Repairs	81.57
		Fencing	109.20
		Travelling Expenses	24.18
		Balance as at 30th June, 1967	36,666.56
	<u>\$48,394.60</u>		<u>\$48,394.60</u>

STATEMENT OF RECEIPTS—CONSOLIDATED REVENUE FUND—FINANCIAL YEAR 1966-67

Head of Receipt	Net Receipts	
	\$	\$
Receipts for Services Rendered—		
Agricultural Colleges and Farms—		
Rents	62,019.81	
Students' Fees	174,485.22	
		236,505.03
Fees—		
Public Officers—Jurors	12.30	
Witness' Expenses	19.54	
Examination Fees	45.00	
Apiary Registrations	4,997.42	
Grading—Dairy Industry Act	13.07	
Licence—Dairy Industry Act	32.80	
Registration—Dairy Industry Act	84.00	
Dairy Science Schools	1,494.00	
Farm Produce Agents' Act, 1926-1932	578.00	
Fertilizer Act—1934	1,615.60	
Pest Destroyers Act, 1945	3,623.80	
Registration of Stock Brands	4,915.67	
Registration of Swine Brands	345.72	
Stock Foods and Medicines Act, 1940	8,144.40	
Veterinary Surgeons' Act, 1923	3,098.69	
		29,020.01
Contributions—		
Commonwealth Government—Administration of Plant Quarantine	149,529.99	
Commonwealth Government—Administration of Animal Quarantine ..	85,462.15	
Commonwealth Government—Administration of Commerce Act	49,589.93	
Commonwealth Government—Maintenance of Gardens at Admiralty House	15,097.14	
		299,679.21
Miscellaneous Services Rendered—		
Plant Diseases Act—Inspection Fees and Fumigation Fees	834.77	
Meat Industry Act—Meat Inspection Fees	783,048.44	
Commonwealth Scientific and Industrial Research Organisation—Subsidy —Vegetable Growing at Hawkesbury Agricultural College	1,000.00	
Laundry Fees—Hawkesbury Agricultural College	6,825.01	
Certification of Seed	34,944.75	
Seed Testing	593.84	
Herd Recording	150,117.31	
Administration of Cattle Compensation Fund	22,262.13	
Commission for Collection of Premiums—Group Assurance, Hospital and Medical Funds, &c.	4,547.35	
Other Miscellaneous Receipts	37,660.33	
		1,041,833.93
Total—Receipts for Services Rendered	\$	1,607,038.18
General Miscellaneous Receipts—		
Rents exclusive of Land	7,723.50	
Fines and Forfeitures	8,157.74	
Sale of Farm produce—Farms and Institutions	314,812.53	
Sale of Government Property	3,060.44	
Commonwealth Government—Contribution for Cattle Tick Control	246,031.12	
Repayment to credit of Consolidated Revenue Fund—Previous Years	158,419.24	
Miscellaneous Receipts on account of Interest	127.05	
Transfer of Part Balances not required	46.91	
Licence Fees—Pastures Protection Act	76.50	
Broadcasting Fees	44.56	
Gas and Electricity	8,457.79	
Postages	98.12	
Telephone Calls (Private)	3,452.03	
3 per cent Contribution—Pastures Protection Boards	74,503.27	
Employer's Liability to State Superannuation Fund	3,789.14	
Conscience Money	40.00	
Commonwealth Grant towards cost of Herd Recording	71,200.00	
Other Miscellaneous Receipts	23.83	
		900,063.77
Total—General Miscellaneous Receipts	\$	
Grand Total—All Revenue	\$	2,507,101.95

MISCELLANEOUS ACCOUNTS

Veterinary Surgeons' Act—No. 25 of 1923 (as amended)

The Act provides for the establishment of the "Board of Veterinary Surgeons of New South Wales". Fees and penalties collected under the Act are paid to the credit of Consolidated Revenue Fund, from which the administrative expenses of the Board are met.

As at 30th June, 1967, 613 Veterinary Surgeons were registered.

Hereunder is the Statements of Receipts and Payments for the year ended 30th June, 1967:

RECEIPTS		PAYMENTS	
	\$		\$
Registration Fees	158.81	Salaries	1,557.00
Roll Fees	2,658.48	Members' Fees	470.40
Restoration Fees	8.40	Travelling Expenses	26.85
Examination Fees	273.00	Postal Expenses	86.85
		Examinations Fees for Foreign Graduates	126.00
		Printing	480.13
		Excess of Receipts over Payments	351.46
	<u>\$3,098.69</u>		<u>\$3,098.69</u>

Meat Inspection Service

The Meat Inspection Service is administered by virtue of the Meat Industry Act, 1915 (as amended) which Act makes provision for a scale of inspection fees.

The following table is a Statement of Receipts and Payments in connection with the service for the year ended 30th June, 1967:

RECEIPTS		PAYMENTS	
	\$		\$
Inspection Fees—		Salaries and Wages	746,021.28
Regulation No. 7	449,151.03	Casual Labour	8,694.80
Regulation No. 8	95,812.10	Allowances	322.52
Regulation No. 9	201,882.02	Retirement Leave	8,238.08
Regulation No. 10	36,203.29	Tea Money	162.00
		Metropolitan Meat Industry Board Endowment	
		Fund Contribution	6,218.09
		Rent	1,407.53
		Travelling Expenses	44,046.57
		Motor Vehicle Running Costs	341.33
		Freight and Cartage	193.65
		Books and Periodicals	42.30
		Postal and Telephone Expenses	804.81
		Fees for Services Rendered	157.75
		General Stores	7,340.81
		Gas and Electricity	15.85
		Advertising	3.30
		Printing	614.97
Excess of Payments over Receipts	41,577.20		
	<u>\$824,625.64</u>		<u>\$824,625.64</u>

In addition to the deficiency of \$41,577.20 shown above, overhead expenses amounting to \$150,943.22 should be taken into account. These include Employer's Superannuation Contribution, Workers' Compensation Insurance and Payroll Tax, calculated at 20 per cent of the cost of salaries and wages (\$754,716.08). This amount increases the deficiency to \$192,520.42.

Fund Created by the Wheat Marketing (Barring of Claims) Act, No. 22 of 1929 (as amended)

REVENUE ACCOUNT FOR THE YEAR ENDED 30TH JUNE, 1967

	\$		\$
To Balance	4,790.40	By Interest on Investments	4,790.40
(Net Surplus transferred to Accumulated Funds Account)		(including Savings Bank Interest)	
	<u>\$4,790.40</u>		<u>\$4,790.40</u>

BALANCE SHEET AS AT 30TH JUNE, 1967

LIABILITIES		ASSETS	
	\$		\$
Accumulated Funds—		Investments in Government Securities (Face Value)	93,600.00
Balances as at 1st July, 1966 ..	96,862.53	Balance in Savings Bank	8,250.26
Net surplus for year ended 30th June, 1967	4,790.40	Interest accrued to 30th June, 1967	1,002.67
	<u>101,652.93</u>		
Commitment as at 30th June, 1967	1,200.00		
	<u>\$102,852.93</u>		<u>\$102,852.93</u>

Dairy Products Factory—Hawkesbury Agricultural College

The operations of the Dairy Products Factory for the financial year 1966-67 resulted in a loss of \$28,777.54.

Abridged accounts are set out hereunder:

MANUFACTURING AND TRADING ACCOUNT, FOR THE YEAR ENDED 30TH JUNE, 1967

	\$		\$
Stock on hand at 1st July, 1967	7,058.09	Sales	374,746.83
Purchases	309,332.38	Stock on hand at 30th June, 1967	18,383.21
Repairs and Maintenance	9,083.30		
Fuel, Light and Power	8,894.50		
Water	3,094.01		
Salaries and Wages	22,213.50		
Workers' Compensation Insurance Premiums..	258.11		
Payroll Tax	553.97		
Superannuation—Employer's Liability	1,936.26		
Depreciation	26,342.21		
Sundry Expenditure	605.30		
	<u>\$389,371.63</u>		
Gross Profit	3,758.41		
	<u>\$393,130.04</u>		<u>\$393,130.04</u>

PROFIT AND LOSS ACCOUNT FOR THE YEAR ENDED 30TH JUNE, 1967

	\$		\$
Salaries and Wages	7,994.65	Gross Profit from Manufacturing and Trading Account	3,758.41
Payroll Tax	193.30	Sundry Income	105.68
Workers' Compensation Insurance Premium...	90.05	Net Loss	28,777.54
Superannuation—Employer's Liability	348.40		
Levies—Butter and Cheese	1,640.44		
Printing and Stationery	481.99		
Freight and Cartage	840.74		
Laboratory Expenses	444.84		
Repairs and Maintenance	573.62		
Telephone	328.17		
Depreciation	1,519.26		
General Expenses	198.27		
Interest on Capital	17,987.90		
	<u>\$32,641.63</u>		<u>\$32,641.63</u>

APPROPRIATION ACCOUNT FOR THE YEAR ENDED 30TH JUNE, 1967

	\$		\$
Loss on Disposal of Plant	2,429.14	Balance as at 1st July, 1966	38,275.48
Adjustment of Value of Deposits	3,004.64	Expenditure not met from Working Account ..	24,640.65
Net Loss 1966-67	28,777.54		
Balance as at 30th June, 1967	28,704.81		
	<u>\$62,916.13</u>		<u>\$62,916.13</u>

APPENDIX II

Published Matter*, 1966-67

*Viz.:—Matter printed as Department of Agriculture (D. of A.) booklets, or contributed to and printed as articles either in Department of Agriculture journals (the monthly *Agricultural Gazette of N.S.W.*, quarterly *Review of Marketing and Agricultural Economics*, bi-monthly *Dairy Topics*, monthly *Poultry Notes*, biannual *Veterinary Notes*, the periodical *Research and the Farmer*) or the journals of other institutions/organizations; and papers published in the proceedings of technical conferences.

The Appendix does not list the many times greater volume of items contributed in the course of extension work through such channels as the Department's weekly printed *Press Copy*, and the Regional/District publicity releases for newspapers and radio stations. Indications of the volume of this published matter are included in this report under "Division of Information Services" and "Regional Extension Services".

RESEARCH STATIONS BRANCH

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FARM MECHANIZATION ADVISORY SERVICE

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DIVISION OF PLANT INDUSTRY

D. of A. Booklets

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Anon. (1967)—Pumpkin growing. (Bulletin P. 36.)

Anon. (1966)—Rock melon culture. (Bulletin P. 47.)

Boyle (1967)—Irrigated maize—inland areas. (Bulletin P. 332.)

Jessup, J. E. (1966)—Irrigated wheat production in N.S.W. (Bulletin P. 334.)

McDonald, D. J. (1966)—Introduction to rice growing on the Murrumbidgee irrigation areas. (Bulletin P. 229)

Smart, B. K. (1966)—Barley growing in N.S.W. (Bulletin P. 317.)

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Anon. (1966)—The banana-growing industry, N.S.W. (Bulletin H. 125).

Blundell, D. R., and Boxwell, P. C. (1967)—Apricot growing under irrigation. (Bulletin H. 164).

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(i) AGRICULTURAL RESEARCH INSTITUTE, WAGGA WAGGA

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AGRICULTURAL COLLEGES

(i) Hawkesbury Agricultural College.

(ii) Wagga Agricultural College.

(iii) Yanco Agricultural College.

Publications by officers located in the Colleges are included with publications listed under the various Divisions to which they are responsible.

APPENDIX III

Schools and Courses wherein the N.S.W. Department of Agriculture was a Major Staffing and/or Organizing Element in 1966-67

Subject-Matter	Type* (School or Course etc.)	Location	Sponsor and/or Department's Organizing Associate	Attendance	Duration
Drought Matters:					
Drought Feeding	School	Balranald	Pastures Protection Board	Not record- ed.	1 day.
Drought Feeding	School	Hay	Graziers Association	25	1 day.
Drought Feeding	School	Hillston	Graziers Association	54	1 day.
Drought Feeding	School	Moulamein	Pastures Protection Board	Not record- ed.	1 day.
Drought Feeding	School	Wentworth	Pastures Protection Board	Not record- ed.	1 day.
Feeding and Management in Dry Times.	School	Cowra	Agricultural Bureau	40	1 day.
Engineering and Machinery:					
Tractor Maintenance ..	School	Carabost	Agricultural Bureau	12	1 day.
Tractor Maintenance ..	School	Tarcutta	A.P.P.U.	10	1 day.
Welding on the Farm ..	School	Blayney	Agricultural Bureau	Not record- ed.	1 day.
Welding on the Farm ..	School	Merriwa	Agricultural Bureau	16	1 day.
Farm Management/ Economics:					
Farm Planning	School	Bingara	Agricultural Bureau	43	2 days.
Farm Planning	Course	Dorrigo	Agricultural Bureau	28	4 nights (in 4 weeks).
Farm Management	School	Armidale	University of New England	35	5 days.
Rural Finance and Farm Management	School	Bingara	Agricultural Bureau	60	2 days.
Fertilizers and Soils:					
Fertilizers	School	Boorowa	Agricultural Bureau	24	2 days.
Fertilizers	School	Coonabarabran	Agricultural Bureau	90	1 day.
Fertilizers	School	Cowra	Agricultural Bureau	87	2 days.
Fertilizers	Course ..	Mangrove Mountain.	Agricultural Bureau	Not on record.	4 nights (in 4 weeks).
Fertilizers	School	Merriwa	Agricultural Bureau	50	2 days.
Fertilizers	School	Moree	Australian Fertilizers Ltd ..	100	1 day.
Fertilizers	School	Tenterfield	Co-op. Dairy Factory	130	1 day.
Fertilizers	School	Wellington	Agricultural Bureau	10	2 days.
Fruit Tree Nutrition ..	School	Young	Agricultural Bureau	33	1 day.
Soil Fertility	Course ..	Dungog	Agricultural Bureau	73	4 lectures (2 per day, 2 weeks.)
Soil Fertility	Course ..	Wauchope	Agricultural Bureau	35	4 lectures (1 per week).
Soil Science	Course ..	Maitland	Dept. Technical Education	Not on record here.	
Wheat Nutrition	School	Cowra	Agricultural Bureau	110	1 day.
Wheat Nutrition	School	Condobolin	Agricultural Bureau	80	1 day.
Wheat Nutrition	School	Dubbo	Agricultural Bureau	130	1 day.
Wheat Nutrition	School	Lake Cargelligo	Agricultural Bureau	75	1 day.
Wheat Nutrition	School	Parkes	Agricultural Bureau	120	1 day.
Wheat Nutrition	School	Trundle	Agricultural Bureau	75	1 day.
Wheat Nutrition	School	West Wyalong	Agricultural Bureau	85	1 day.
Wheat Nutrition	School	Young	Agricultural Bureau	52	1 day.
Fodder Matters: (see also under "Pasture Matters").					
Fodder Conservation ..	School	Coonabarabran	Agricultural Bureau	6	1 day.
Fodder Conservation ..	School	Cowra	Agricultural Bureau	54	2 days.
Fodder Conservation ..	Symposium	Mallangance ..	Agricultural Bureau	40	1 day.
Fodder Conservation ..	Symposium	Tenterfield	Agricultural Bureau	26	1 day.
Fodder Crops	School	Forbes	Agricultural Bureau	30	1 day.
Fodder Crops	School	Goulburn	Agricultural Bureau	60	1 day.
Fruit Industry Matters:					
Fruit Packing	Course ..	Orange		48	2 days.
Homemaker:					
Dressmaking Made Easy	School	Marrar	C.W.A.	26	1 day.
Everyday Food and Party Fare.	School	Woodstock	C.W.A.	50	1 day.
First Aid	School	Dooralong	Agricultural Bureau (women).	22	1 day.
First Aid	School	Orangeville	Agricultural Bureau (women).	22	1 day.
Floral Arrangement	School	Blayney	C.W.A.	32	1 day.
Food Presentation	School	Lake Cargelligo	Agricultural Bureau (women).	42	1 day.
Gardens, and Garden Planning.	School	Hampton	Agricultural Bureau (women).	22	1 day.
Gardens, and Garden Planning.	School	Kiacatoo	Agricultural Bureau (women).	50	1 day.
Hair Care	School	Eaurimbl	Agricultural Bureau (women).	70	1 day.

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Schools and Courses wherein the N.S.W. Department of Agriculture was a Major Staffing and/or Organizing
Element in 1966-67—*continued*

Subject-Matter	Type* (School or Course etc.)	Location	Sponsor and/or Department's Organizing Associate	Attendance	Duration
Hair Care	School	Southern Cross	Agricultural Bureau (women).	40	1 day.
Hair Care	School	Tottenham ..	Agricultural Bureau (women)	38	1 day.
Hair Care	School	Trundle	Agricultural Bureau (women).	40	1 day.
Hair Care	School	Valla	Agricultural Bureau (women).	28	1 day.
Hair Care	School	Yarramalong	Agricultural Bureau (women).	70	1 day.
Home Furnishing and Decoration.	School	Baan Baa	C.W.A.	20	1 day.
Home Furnishing and Decoration.	School	Bowral	C.W.A.	32	1 day.
Home Furnishing and Decoration.	School	Brocklesby ..	C.W.A.	45	1 day.
Home Furnishing and Decoration.	School	Jindabyne	Agricultural Bureau (women).	18	1 day.
Home Furnishing and Decoration.	School	The Rock	C.W.A.	37	1 day.
Home Furnishing and Decoration.	School	Tooma	C.W.A.	23	1 day.
Home Furnishing and Decoration.	School	Wellington ..	Agricultural Bureau (women).	44	1 day.
Home Nursing	School	Bowraville	Agricultural Bureau (women).	21	1 day.
Home Nursing	School	Coffs Harbour	Agricultural Bureau (women).	40	1 day.
Home Nursing	School	Dorrigo	Agricultural Bureau (women).	18	1 day.
Home Nursing	School	Ettalong	C.W.A.	Not record- ed.	1 day.
Home Nursing	School	Rye Park	Agricultural Bureau (women).	30	1 day.
Lapidary	School	Avoca	Agricultural Bureau (women).	40 and 82	2 x 1 days.
Lapidary	School	Trundle	Agricultural Bureau (women).	50	1 day.
Millinery Magic	School	Avoca	Agricultural Bureau (women).	32	1 day.
Millinery Magic	School	Wellington ..	Agricultural Bureau (women).	45	1 day.
Pattern Adjustment	School	Berridale	Agricultural Bureau (women).	6	1 day.
Pattern Adjustment	School	Merriwa	Agricultural Bureau (women).	19	1 day.
Planned Work: More Leisure.	School	Bexhill	Agricultural Bureau (women).	17	1 day.
Planned Work: More Leisure.	School	Gunning Gap ..	Agricultural Bureau (women).	28	1 day.
Steps to Better Dress- making.	School	Tumbarumba ..	Tumbarumba Women's Association.	12	1 day.
Wardrobe Planning	School	Baradine	Agricultural Bureau (women).	33	1 day.
Wardrobe Planning	School	Dunedoo	Agricultural Bureau (women).	11	1 day.
Wardrobe Planning	School	Gwabegar	C.W.A.	21	1 day.
Wardrobe Planning	School	Lake Cargelligo	Agricultural Bureau (women).	31	1 day.
Wardrobe Planning	School	Macksville	C.W.A.	20	1 day.
Industry Operative: Citrus Packing-Shed Op- eratives.	School	Gosford	C.S.I.R.O. and Packing Sheds.	60	3 days.
Dairy Factory Operatives; Refresher.	School	H.A. College ..	Dairy Produce Factories ..	11	5 days.
Dairy Science	School	Albury	Dairy Produce Factories ..	12	5 days.
Dairy Science	School	Hexham	Dairy Produce Factories ..	11	3 days.
Dairy Science	School	Lismore	Dairy Produce Factories ..	17	4 days.
Dairy Science	School	Nowra	Dairy Produce Factories ..	17	3 days.
Dairy Science	School	Raleigh	Dairy Produce Factories ..	18	5 days.
Dairy Science	School	Singleton	Dairy Produce Factories ..	26	5 days.
Milk Grading	School	Albury	Dairy Produce Factories ..	11	3 days.
Milk Grading	School	Bega	Dairy Produce Factories ..	6	3 days.
Milk Grading	School	Camden	Dairy Produce Factories ..	7	3 days.
Milk Grading	School	Camden	Dairy Produce Factories ..	13	3 days.
Milk Grading	School	Grafton	Dairy Produce Factories ..	10	3 days.
Milk Grading	School	Moruya	Dairy Produce Factories ..	8	3 days.
Milk Grading	School	Orange	Dairy Produce Factories ..	4	4 days.
Milk Grading	School	Raleigh	Dairy Produce Factories ..	17	3 days.
Milk Grading	School	Windsor	Dairy Produce Factories ..	8	3 days.
Milk Grading	School	Wyong	Dairy Produce Factories ..	5	3 days.

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Schools and Courses wherein the N.S.W. Department of Agriculture was a Major Staffing and/or Organizing Element in 1966-67—*continued*

Subject-Matter	Type* (School or Course etc.)	Location	Sponsor and/or Department's Organizing Associate	Attendance	Duration
In-Service Training:					
Beef Cattle Industry	Symposium	Tamworth		12	3 days.
Dairy Herd Recording ..	School	H.A. College ..		41	4 days.
Dairy Products—Manu- facture.	Seminar ..	Farrer Place ..	Aust. Dairy Produce Board	50	5 days.
Dairy Technology ..	School	Finley	Dairy Produce Factories ..	24	5 days.
Extension Service Prin- ciples and Methods.	School	H.A. College ..		50	11 days.
Farm Management, Econ- omics and Principles.	School	Grafton		30	5 days.
Farm Management, Econ- omics and Principles.	School	W.A. College ..		50	5 days.
Fruit Inspector-Training	School	Farrer Place ..		20	5 days.
Irrigation	School	H.A. College ..		53	4 days.
Pesticides	School	Rydalmere (Division of Sci- ence Services).		Not record- ed.	2 days.
Poultry Officers (Com- monwealth-wide).	School	H.A. College ..	Inter-state Departments and Australian Agricultural Council.	33	12 days.
Sheep and Wool Officers	Seminar ..	H.A. College ..	C.S.I.R.O. and Universities	60	4 days.
Trainee Induction (Univ- ersity and Agricultural College trainees).	School	Farrer Place ..		60	2 days.
Water Testing	Course ..	Wagga		12	2 days.
Irrigation; and Farm Water Supplies:					
Farm Water Supplies ..	Symposium	Mudgee	Agricultural Bureau	60	1 day.
Irrigation	School	Macksville	Agricultural Bureau	39	2 days.
Leadership:					
Public Speaking, and Meeting Procedure.	School	Bogan Gate	C.W.A. and Agricultural Bureau (women).	32	3 days.
Public Speaking, and Meeting Procedure.	School	Bingara	Agricultural Bureau (women).	52	1 day.
Public Speaking, and Meeting Procedure.	School	Dubbo	Penguin Club (women).	38	1 day.
Public Speaking, and Meeting Procedure.	School	Inverell	Agricultural Bureau (women).	38	1 day.
Public Speaking, and Meeting Procedure.	School	Somersby	Central Coast Res. & Ext. Comm.	28	1 day.
Public Speaking, and Meeting Procedure.	School	Yass	C.W.A.	37	3 days.
Personality and Poise ..	School	Courabyra	C.W.A.	28	1 day.
Personality and Poise ..	School	Condobolin	C.W.A.	48	1 day.
Personality and Poise ..	School	Dorrigo	Agricultural Bureau (women).	29	1 day.
Personality and Poise ..	School	Gouldsville	Agricultural Bureau (women).	102	1 day.
Personality and Poise ..	School	Millthorpe	Agricultural Bureau (women).	18	1 day.
Personality and Poise ..	School	Tumut	C.W.A.	48	1 day.
Understanding Ourselves	School	Ettalong Beach	C.W.A.	28	1 day.
Understanding Ourselves	School	Coleambally ..	Agricultural Bureau (women).	28	1 day.
Understanding Ourselves	School	Tumbarumba ..	C.W.A.	10	1 day.
Understanding Ourselves	School	Bryan's Gap....	Agricultural Bureau (women).	43	1 day.
Voice, Speech, and Per- sonality.	School	Dubbo	C.W.A.	26	1 day.
Livestock: (see also under "Pastures, etc.")					
Animal Reproduction ..	School	Collarenebri ..	Graziers Association	Not on record.	1 day.
Animal Reproduction ..	School	Dunedoo	Agricultural Bureau	21	1 day.
Animal Reproduction ..	School	Mary's Mount	Agricultural Bureau	Not on record.	1 day.
Animal Reproduction ..	School	Mungindi	Graziers Association	Not on record.	1 day.
Animal Reproduction ..	School	Narrabri	Agricultural Bureau	Not on record.	1 day.
Animal Reproduction ..	School	Quirindi	Agricultural Bureau	Not on record.	1 day.
Animal Reproduction ..	School	Walgett	Agricultural Bureau	Not on record.	1 day.
Animal Reproduction ..	School	Warialda	Farmers Group	Not on record.	1 day.
Beckkeeping	School	H.A. College ..		22	5 days.
Cattle Feeds and Nu- trition.	Course ..	Dungog	Agricultural Bureau	47	4 lectures (2 per week).
Cattle Reproduction ..	Course ..	Wyong	Agricultural Bureau	30	5 nights (1 per week).

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Schools and Courses wherein the N.S.W. Department of Agriculture was a Major Staffing and/or Organizing Element in 1966-67—*continued*

Subject-Matter	Type* (School or Course etc.)	Location	Sponsor and/or Department's Organizing Associate	Attendance	Duration
Cattle and Sheep Re- production.	School	Coonabarabran	Agricultural Bureau	34	2 days.
Lamb Production	School	Goulburn	Agricultural Bureau	103	1 day.
Lamb Production	School	Cooma	Agricultural Bureau	Not on record.	1 day.
Livestock Reproduction	Seminar ..	Ashford		Not on record.	1 day.
Livestock Reproduction	Seminar ..	Barraba		25	1 day.
Livestock Reproduction	Seminar ..	Bingara	Agricultural Bureau	Not on record.	1 day.
Livestock Reproduction	Seminar ..	Glen Innes ..	Agricultural Bureau	11	1 day.
Livestock Reproduction	Seminar ..	Inverell	Agricultural Bureau	Not on record.	1 day.
Livestock Reproduction	Seminar ..	Manilla		20	1 day.
Livestock Reproduction	Seminar ..	Nundle	Agricultural Bureau	16	1 day.
Livestock Reproduction	Seminar ..	Tamworth	Agricultural Bureau	18	1 day.
Livestock Reproduction	Seminar ..	Tenterfield ...	Agricultural Bureau	11	1 day.
Livestock Reproduction	Seminar ..	Uralla	Agricultural Bureau	7	1 day.
Livestock Reproduction	Seminar ..	Walcha	Agricultural Bureau	19	1 day.
Livestock Reproduction	Seminar ..	Werris Creek ..	Agricultural Bureau	9	1 day.
Meat Marketing	School	Walgett	Agricultural Bureau	52	2 days.
Pig Raising	School	Forbes	Agricultural Bureau	83	1 day.
Pig Raising	School	Gilgandra	Pig Breeders' Association ..	Not on record.	1 day.
Pig Raising	School	H.A. College ..		40	5 days.
Pig Raising	School	Lake Cargelligo	Agricultural Bureau	46	1 day.
Pig Raising	School	West Wyalong	Agricultural Bureau	65	1 day.
Poultry Farming	School	H.A. College ..		38	5 days.
Raising Healthy Lambs	School	Bombala	Agricultural Bureau	33	1 day.
Raising Healthy Lambs..	School	Cooma	Agricultural Bureau	52	1 day.
Shearing	School	Lockhart		Not on record.	5 days.
Sheep Diseases	Course ..	Manilla	Agric. Bureau and U.F.W.A.	28	4 lectures (1 per week).
Sheep Nutrition	School	Ariah Park	Agricultural Bureau	28	2 days.
Sheep Nutrition	School	Cootamundra ..	Agricultural Bureau	45	2 days.
Sheep Reproduction ..	School	Bathurst	Agricultural Bureau	46	1 day.
Sheep Reproduction ..	Course ..	Boorowa	Agricultural Bureau	45	4 lectures (1 per week).
Sheep Reproduction ..	School	Young	Agricultural Bureau	40	1 day.
Turkey Raising	School	W.A. College ..	Turkey Breeders' Asso- ciation,	80	4 days.
Pastures and Pastoral:					
Grazing Industry	School	Hillston	Graziers Association	Not on record.	1 day.
Grazing Industry	School	Inveralochy ..	U.F.W.A. and Agric. Bureau	70	5 days.
Grazing Industry	School	Tuena	Agricultural Bureau	35	1 day.
Grazing Industry	School	Tuena	Agricultural Bureau	41	1 day.
Pasture and Animal Hus- bandry.	School	Glen Innes ..	Graziers Association	100	1 day.
Pasture Establishment and Management.	School	Dunedoo	Agricultural Bureau	55	1 day.
Pasture Improvement ..	School	Inverell	Agricultural Bureau	80	2 days.
Pasture Production	School	Bathurst	Agricultural Bureau	90	1 day.
Pasture Production	School	Walcha	Graziers Association	180	1 day.
Pasture Production	School	West Wyalong	Agricultural Bureau	80	1 day.
Pastures and Summer Crops.	School	Wauchope	Agricultural Bureau	50	1 day.
Pasture Utilization	School	Boorowa	Agricultural Bureau	39	1 day.
Pasture Utilization	Seminar ..	Mudgee	Agricultural Bureau	40	1 day.
Pasture Utilization	School	Parkes	Agricultural Bureau	80	1 day.
Pasture Utilization	School	Young	Agricultural Bureau	40	1 day.
Rural Youth Organisation:					
Agriculture: General ..	School	W.A. College ..	N.S.W. R.Y.O. (Ex. J.F.C.)	20	5 days.
Entomology	School	H.A. College ..	N.S.W. R.Y.O. (Ex. J.F.C.)	20	5 days.
Pig Raising	School	H.A. College ..	N.S.W. R.Y.O. (Ex. J.F.C.)	20	5 days.
University Undergraduates (Syd):					
Extension Principles and Methods.	School	Newport Hostel	School of Agric., Univ. of Sydney.	43	5 days.
Extension Principles and Methods.	School ..	Newport Hostel	School of Agric., Univ. of Sydney.	42	5 days.
Weeds and Allied Problems:					
Timber and Weed Control	School	Walgett	Agricultural Bureau	46	2 days.
Timber Control	School	Mullion Creek	Agricultural Bureau	41	1 day.
Weed Control	School	Kyogle	Agricultural Bureau	46	3 days.
Weed Control	School	Warialda	Agricultural Bureau	Not record- ed.	1 day.
Wheat Industry: (see also under "Fertilizers and Soils")					
Wheat Production	School	Baradine	Agricultural Bureau	35	2 days.
Wheat Production	School	Bingara	Agricultural Bureau	55	1 day.
Wheat Production	School	Inverell	Agricultural Bureau	65	1 day.

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APPENDIX IV

Staff Branch Notes on Staff changes; appointments/promotions/retirements/deaths; Staff numbers; Officers overseas.

NEW SALARY AGREEMENTS PROCESSED

Fourteen new Agreements and Awards affecting salaries or wages of Departmental personnel were received, and the necessary adjustments of salaries have been made.

STAFF NUMBERS AT 30TH JUNE, 1967

Group	Public Service Board	Ministerial	Totals	Casuals included in Ministerial
Central Administration	699	Nil	699	Nil
Division of Science Services	170	Nil	170	Nil
Division of Plant Industry	229	Nil	229	Nil
Division of Horticulture	196	Nil	196	Nil
Division of Dairying	238	Nil	238	Nil
Division of Animal Industry:				
Head and District Offices	270	14	284	Nil
Queensland Border	69	1	70	Nil
Tick Quarantine Areas	43	509	552	8
Meat Inspection Services	201	21	222	Nil
Royal Botanic Gardens	159	2	161	Nil
Hawkesbury Agricultural College	73	93	166	1
Wagga Agricultural College	41	74	115	Nil
Yanco Agricultural College & Research Station	30	42	72	Nil
Research Stations Branch	141	184	325	Nil
Totals	2559	940	3499	9

*Including Division of Marketing and Agricultural Economics, Division of Information Services.

Staff Changes

Appointments/Promotions.—In all, 166 officers were promoted during the year, and 60 of these were promoted out of seniority order.

Some of the appointments/promotions were as follows: Mr A. Pearson from Chief of Research Stations Branch to Deputy Director-General (Professional & Technical Services), a newly established position; Mr B. Owen French from Chief of Division of Horticulture to Deputy Director-General (P. & T.) on the death of Mr A. Pearson; Mr N. K. Golding from Deputy Chief, Division of Animal Industry to Chief of Research Stations Branch; and Mr J. N. Henry to Deputy Chief, Division of Animal Industry *vice* Mr Golding; Mr R. G. S. Kebby from Deputy Chief to Chief of Division of Horticulture; Mr G. R.

Gregory from Principal Fruit Officer to Deputy Chief, Division of Horticulture; Mr A. H. Skepper to Principal Fruit Officer (Regulatory), a newly established position; Mr T. H. Johns from Chief Chemist to Chief of Division of Science Services; Mr A. N. Old from Senior Chemist to Chief Chemist and Dr D. K. O'Neill to Senior Chemist *vice* Mr Old; Mr K. E. Hutton from Plant Pathologist, to newly established position of Executive Assistant to Deputy Director-General (Research and Education); Mr S. Wise from Administrative Assistant and Personnel Officer to Assistant Secretary, a newly established position; Mr F. D. McKenzie from Manager to status of Principal of Yanco Agricultural College and Research Station; and Mr K. W. Bannister from Lecturer to Deputy Principal of that institution; Mr G. A. Pasfield from Senior to Chief Entomologist and Dr G. J. Shanahan from Special Grade to Senior Entomologist; Mr J. H. P. Dingle from Chemist, Tick Board of Control Laboratory, to Senior Chemist (Pesticides); Mr A. N. A. Harris from District Veterinary Officer to Chairman, Board of Tick Control; Mr D. H. Mumford from D.V.O. to Assistant Principal Veterinary Officer (Disease Control); Mr G. D. Slennett from Acting Principal to Principal Livestock Officer (Poultry); Mr E. W. Bowmaker from Special Agronomist (Irrigation) to Principal Agronomist (Extension); Mr C. Walkden-Brown from Special to Principal Agronomist (Cereals); Mr A. D. Mears from Agronomist to Assistant to Special Agronomist (Weeds); Mr B. D. Ament from Regional Supervisor, Western Region, to Principal Extension Officer (Regional Extension Services), a newly established position; and Mr H. T. Harrison from Livestock Officer (Beef Cattle) to Regional Supervisor (Western Region) *vice* Mr Ament; Mr C. R. Hood from Manager, Leeton Research Station, to Assistant Principal Officer (Management), a newly established position in Research Stations Branch; Mr P. A. Witschi from Research Agronomist to Manager, Leeton Research Station; Mr J. W. Turpin from Manager, Dareton Horticultural Research Station to Special Fruit Officer (Citrus), Division of Horticulture, and Mr M. C. Stannard from Fruit Research Officer to Manager at the Dareton Station, *vice* Mr Turpin; Mr B. M. Braithwaite to Special Entomologist; Mr J. J. McCormick from Staff Officer to Senior Clerk (Administration); Mr E. A. Bragg from Acting Assistant to Assistant Accountant; Mr D. McGregor from O.I.C. Correspondence & Records, to Pastures Protection Officer.

Retirements.—Dr C. J. P. Magee, Chief of Division of Science Services; Mr P. C. Hely, Chief Entomologist; Mr G. Nicholson, Principal Agronomist (Extension).

Deaths.—Mr A. Pearson, Deputy Director-General (P. & T.); Mr D. J. McRae, Livestock Officer (Pigs).

OFFICERS OVERSEAS

Name	Designation	Duration	Reason for Visit
J. Nolan	Research Officer	15.8.65–14.8.68	Post-graduate studies at the University of California.
G. L. G. Lee	Livestock Research Officer (Apiculture)	9.9.65–8.9.67	Assistantship at the University of California, Leave without pay for 2 years.
D. E. Wallin	Agronomist	14.9.65–13.9.66	Study Cotton Growing in U.S.A.
G. R. Hughes	Agronomist	24.9.65–23.9.68	Research Assistantship at the University of Illinois for Ph.D.
Dr W. V. Single	Director of Research, Tamworth A.R.S.	24.1.66–18.11.66	Visit Wheat Research Centres in U.S.A., Japan, Canada, Europe and U.K.
Dr J. M. Holder	Special Veterinary Research Officer	7.5.66–11.9.66	Attend 10th International Grassland Congress in Helsinki; 9th International Congress in Animal Production, Edinburgh; and visit research centres
D. W. Crowfoot	Chief, Division of Dairying	6.6.66–26.9.66	Attend XVII International Dairy Congress Munich; and visit research centres in U.S.A., U.K., and Europe.
C. Walkden-Brown	Special Agronomist	14.6.66–30.9.66	Investigate cereal production techniques, Europe, U.K. & U.S.A.
S. G. Grimmett	Senior Agronomist	18.6.66–14.9.66	Attend 10th International Grasslands Congress in Helsinki; and visit pasture research centres in Finland and 12 other countries.
B. D. Ament	Regional Supervisor	29.6.66–30.10.66	Attend course in Agricultural Extension at Wageningen, The Netherlands, and to observe agricultural extension in U.S.A., Canada, U.K. and Europe.
H. C. Kirton	Biometrician	28.8.65–27.8.66	Study Leave in U.K.
Dr L. Frazer	Senior Biologist	25.3.66–10.7.66	Colombo Plan Assignment in India.
Dr L. Frazer	Senior Biologist	30.9.66–14.11.66	Europe and South Africa: 4th Conference of the International Organisation of Citrus Virologists.

OFFICERS OVERSEAS—continued.

Name	Designation	Duration	Reason for Visit
W. H. Smith	Inspector, P.D. Act.	27.5.65–27.5.67	“On Loan” to the Western Samoan Govt. for a period of 2 yrs. Leave without pay to undertake control of “Bunchy Top” and the improvement of the banana industry.
Dr C. D. Thorsby	Economics Research Officer ..	10.8.65–16.1.67	Leave without pay to accept a temporary Lectureship at the London School of Economics.
B. O. French	Deputy Director-General (P.T.)	6.8.66–19.11.66	Attend International Horticultural Congress in Maryland and to visit Horticultural centres in U.S.A., U.K. & Europe, South Africa and Jamaica.
B. O. E. Calder	Dairy Officer	20.8.66–3.9.66	Attend Conference & school on Dairy Hygiene Machine Milking at the University of Auckland, New Zealand.
D. A. Dickinson	Asst. Princ. Vet. Officer	13.8.66–1.10.66	Investigate outbreak of exotic disease in U.K. and attend FAO Conference on Sheep Diseases in Rome.
A. K. Sheridan	Livestock Research Officer ..	5.2.67–24.2.67	Attend Massey University Poultry Convention in New Zealand.
W. Poggendorf	Chief, Division of Plant Industry	30.9.66–26.11.66	India and Asian Countries.
J. H. Ballard	Assist. Princ. Agronomist	20.1.67–3.2.67	Attend Near East Regional Conference on Dryland Farming in the Sudan, also visited London and Rome.
B. M. Braithwaite	Entomologist	4.3.67–12.4.67	Investigate the clover root weevil in New Zealand.
Dr R. B. Dun	Director of Animal Production	22.2.67–23.3.67	Visit New Zealand Research Institutes.
B. R. Wilson	Livestock Research Officer ..	9.4.67–30.4.67	Visit New Zealand Institutes regarding Pig Production Research.
N. C. Lloyd	Entomologist	19.5.67–27.9.67	Investigate developments of pests in pome fruit—New Zealand, U.S.A., Canada, Switzerland & Italy.
A. A. Clemson	Principal Livestock Officer (Apiculture)	8.5.67–7.9.67	Investigate Bee Industry U.S.A., Canada, Europe & Russia.
C. W. Brett	Livestock Officer (Beef Cattle)	11.3.67–6.5.67	Accept Rotary international scholarship, U.S.A.
R. Robertson	Senior Inspector, Export & Import.	7.3.67–7.9.67	On secondment to act as Assistant Fruit Officer, London.
J. G. Drever	Agricultural Engineer	10.6.67–23.9.67	Attend North American National Conference of Agricultural Engineers and visit research centres.
F. A. York	Special Agronomist	14.6.67–23.9.76	Investigate Fodder conservation practices and Research, U.S.A., Canada and U.K.
M. Casimir	Entomologist	July 66–Sept 66	Locust and Grasshopper Research and Control in U.S.A., U.K., Italy and Africa.
R. J. Roughley	Bacteriologist	5.8.66–4.8.69	Post-graduate study to Ph.D., London, U.K.
B. C. Imire	Senior Agronomist	30.8.66–July 68	Post-graduate study for Ph.D., U.S.A., California.
A. N. Smith	Senior Research Officer	18.8.66–2.11.66	Attend International Soil Science meeting at Aberdeen, Scotland and visit research centres in the U.K., India, Israel, Europe and America.
E. D. Cuthbertson	Senior Research Officer	4.9.66–3.12.66	Attend British Weed Control Conference and visit Research Institutes in U.K., U.S.A., Canada, Europe and Lebanon.
C. J. King	Chief, Division of Marketing and Agricultural Economics.	19.8.66–22.10.66	Visit 13 countries in respect of marketing of meat and other food sponsored by the Meat and Allied Trades Federation of Aust.
P. D. Claxton	Veterinary Officer	23.9.66–30.9.67	Study Leave, Post-graduate training for Diploma of Bacteriology, London, U.K.
A. D. Doyle	Agronomist	15.8.66–30.9.66	Attend International Tobacco Scientific Congress in Athens.
R. Gregory	Princ. Fruit Officer	July 66–Dec. 66	Rudi Buring Memorial Scholar; in U.S.A., Europe, S. Africa; re wine, drying and table-grape industries.

